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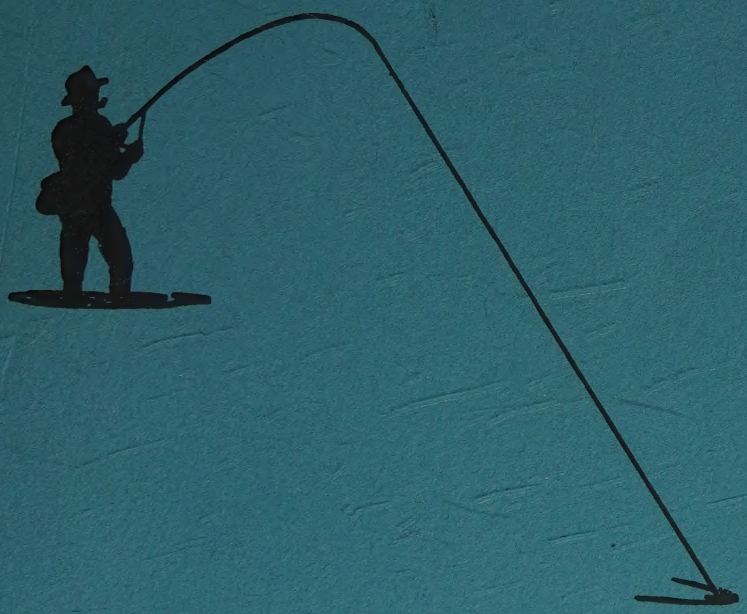

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Sport Fishery Abstracts

An abstracting service for fishery research and management

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Sport Fishery Abstracts is intended to furnish fishery biologists in government agencies and educational institutions with abstracts of the current literature in sport fishery research and management. Abstracts of papers on limnology, ecology, natural history and other fields of specialization will be included when the subject has application to the conservation of sport fish and the restoration of sport fishing.

One volume consisting of not more than four numbers will be issued each year. Each number contains separate Author and Subject indexes, with the final number of each volume containing cumulative indexes.

The last number of each volume contains a list of publications screened for appropriate material. Suggestions for improving the usefulness and coverage of Sport Fishery Abstracts are solicited.

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Prepared in the Branch of Federal Aid
S. E. Jorgensen, Chief
Donald F. LaPointe, Editor

4643. Lauff, George H., Kenneth W. Cummins, Clyde H. Eriksen, and Michael Parker. 1961. A METHOD FOR SORTING BOTTOM FAUNA SAMPLES BY ELUTRIATION. Limnology and Oceanography, Vol. 6, No. 4, pp. 462-466.

A sorting device based on mechanical agitation of a substrate sample in a water column, followed by elutriation, provides a rapid and convenient method of separating benthic faunal components and finer sediment fractions. The operation is efficient in terms of total time of analysis and the percentage of animals removed. The method is versatile and can be modified to meet the needs of specific sampling programs. (Auth.)

4644. Tortonese, Enrico. 1961. MEDITERRANEAN FISHES OF THE FAMILY ISTIOPHORIDAE. Nature, Vol. 192, No. 4797, p. 80.

The Mediterranean fauna certainly includes at least three species of Istiophoridae: Tetrapturus (or perhaps Makaira?) belone Raf. (the commonest known for a long time in the Mediterranean only), Makaira albida (Poey) (Atlantic; recorded from the Bay of Genoa), Istiophorus gladius (Brouss.) (Indo-West Pacific; recorded from Haifa). (Auth.)

4645. Robins, C. Richard. 1961. TWO NEW COTTID FISHES FROM THE FRESH WATERS OF EASTERN UNITED STATES. Copeia, 1961, No. 3, pp. 305-315.

Two new species of sculpins, Cottus girardi and C. baileyi are described. The former is a primitive representative of the carolinae complex and is restricted to the Potomac River system of Pennsylvania, Maryland, Virginia, and West Virginia. The latter, a member of the C. bairdi-cognatus complex, is isolated in the headwaters of the Holston River in Tennessee and Virginia. (Auth.)

4646. Colebrook, J. M., R. S. Glover, and G. A. Robinson, et al. 1961. CONTINUOUS PLANKTON RECORDS CONTRIBUTIONS TOWARDS A PLANKTON ATLAS OF THE NORTH-EASTERN ATLANTIC AND THE NORTH SEA. Bulletins of Marine Ecology, Vol. V, No. 42, pp. 65-111.

The Continuous Plankton Recorder Survey, operated from the Oceanographic Laboratory Edinburgh, is used to provide charts of the distribution and abundance of seventy-nine species and groups of species. The charts show the "average" distributions obtained from nine years' sampling (1948-1956) in the north-eastern Atlantic and the North Sea.

In the General Introduction a continuous biogeographic series is presented in which the species are listed in order from extreme oceanic to extreme neritic forms: there is appreciable overlapping of different types of distribution. The problems of nomenclature and classification of pelagic organisms are discussed. It is suggested that the species-composition of the whole plankton "community" can be used to provide indications of hydrographic and other environmental changes. Notes on the distribution of some of the species are provided in Parts I-V.

This Plankton Atlas is intended to provide a background for subsequent studies of fluctuations in the abundance, distribution, and species-composition of the plankton. (Auth.)

4647. Norden, Carroll R. 1961. THE IDENTIFICATION OF LARVAL YELLOW PERCH, PERCA FLAVESCENS, AND WALLEYE, STIZOSTEDION VITREUM. Copeia, 1961, No. 3, pp. 282-287.

Prolarvae and postlarvae of the yellow perch, Perca flavescens, and of the walleye, Stizostedion vitreum, can be separated by morphometric and meristic characters, and to a lesser extent by differences in pigmentation. The average number of postanal myomeres in all larvae of yellow perch is about seven less than that found in the walleye at similar stages. The average size of the prolarval yellow perch (5.5-7.0 mm. T. L.) is significantly less than that of the walleye (7.4-9.6 mm. T. L.). There is a similar reduction in the size of the yolk sac in the former species when it is compared with the latter. Other differences include the articulation of the lower jaw which is located below the orbit, the character of the teeth, and the longer intestine in the yellow perch, whereas the articulation of the lower jaw is located below the posterior margin of the orbit, some teeth are canine-like, and the intestine is short in the larval walleye.

Chromatophores are more numerous in all larval stages of the walleye as compared with the yellow perch. They are most distinctive on the yolk sac and on the sides and tips of both upper and lower jaw. (Auth.)

4648. Hitz, Charles R., and Allan C. DeLacy. 1961. VARIATION IN THE OCCURRENCE OF CORONAL SPINES IN SEBASTODES AURICULATUS (GIRARD). Copeia, 1961, No. 3, pp. 279-282.

Variation in the number of coronal spines of Sebastodes auriculatus has been a problem with taxonomists for a number of years in the Puget Sound area. In one area of Puget Sound it was found to be 53% with two spines, 25% with one spine (right or left), and 22% zero spines. This variation was not affected by sex or by length of fish. (Auth.)

4649. Weisel, George G. 1961. VARIATIONS IN ANAL FIN RAY COUNT OF A DEME OF REDSIDE SHINERS, RICHARDSONIUS BALTEATUS, FROM A WARM SPRING. Copeia, 1961, No. 3, pp. 270-274.

Anal fin rays of Richardsonius balteatus collected over a nine year period from a single deme living in a comparatively stable environment exhibit slight but statistically significant variations. No sexual differences appear to be present, but there are detectable differences in size and year classes. These variations are attributed to selection, environment, and sampling. However, the variations and fluctuations within the deme are not as pronounced as in comparisons between different populations. (Auth.)

4650. Gosline, William A. 1961. THE PERCIFORM

CAUDAL SKELETON. Copeia, 1961, No. 3, pp. 265-270.

For certain groups of perciform fishes the caudal skeleton appears to be a good indicator of relationships. This paper attempts to provide information on its possibilities and limitations in this regard. The basal percoid type of caudal skeleton is described and certain lines of morphological divergence from this type are discussed. (Auth.)

4651. Patten, B. C. 1961. PRELIMINARY METHOD FOR ESTIMATING STABILITY IN PLANKTON. Science, Vol. 134, No. 3484, pp. 1010-1011.

The stability of plankton in the York River, Virginia, during the summer of 1960 is computed by a derived empirical stability measure. The communities were indicated to have considerable homeostasis, being over five times more stable than the physical biotope. (Auth.)

4652. Boschung, Herbert R., Jr. 1961. AN ANNOTATED LIST OF FISHES FROM THE COOSA RIVER SYSTEM OF ALABAMA. The American Midland Naturalist, Vol. 66, No. 2, pp. 257-285.

A survey of the fish fauna of the Coosa River drainage, a major tributary of the Alabama system, was conducted in June, 1959. Collections were made at 44 stations. The results of these and 10 collections made in previous years, plus records from the literature, show the fish fauna of the Coosa drainage of Georgia and Alabama to comprise 20 families and 85 species. Ten species are endemic to the upper Alabama system, and 10 represent new records for the Coosa drainage. Each collecting station is described and the species collected are listed. Annotations include notes on the morphology, color, and ecology of many of the species. The number of specimens collected at each station, and the size ranges are given for each species. A bibliography for each species is also included. (Auth.)

4653. Gibbs, Robert H., Jr. 1961. CYPRINID FISHES OF THE SUBGENUS CYPRINELLA OF NOTROPIS. IV. THE NOTROPIS GALACTURUS-CAMURUS COMPLEX. The American Midland Naturalist, Vol. 66, No. 2, pp. 337-354.

The species Notropis galacturus and N. camurus are redescribed and differentiated from other species of the subgenus Cyprinella and synonymies are given. These two species form a distinct unit within the subgenus, distinguished by the presence of depigmented basicaudal areas, a hiatus between nuptial tubercles of the snout and those of the top of the head, two rows of tubercles on each chin ramus, and red pigment in dorsal and anal fins of breeding males. Populations of N. galacturus east and west of the Mississippi have differentiated slightly. Lower Mississippi populations of N. camurus are racially distinct from those in the Arkansas system. The two species are probably derived from a common stock which became divided into eastern and western portions. N. galacturus has crossed the Mississippi, but the range of N. camurus appears to have contracted, leaving the two present populations. (Auth.)

4654. Miller, Daniel J., Dan Gotshall, and Richard Nitsos. 1961. A FIELD GUIDE TO SOME COMMON OCEAN SPORT FISHES OF CALIFORNIA. State of California Department of Fish and Game Marine Resources Operations, Part 2, 41 pp.

4655. Moffett, Alan W. 1961. MOVEMENTS AND GROWTH OF SPOTTED SEATROUT, CYNOSCION NEBULOSUS (CUVIER), IN WEST FLORIDA. The Marine Laboratory, Technical Series No. 36, 35 pp.

A total of 5,345 spotted seatrout was tagged at Fort Myers, Cedar Key and Apalachicola on the west coast of Florida.

Body-cavity and internal anchor tags were used. Internal anchor tags are better for short term studies, but body-cavity tags appear to be more permanent.

The total recovery rate was 10.8 per cent. The higher recovery rate at Apalachicola (17.3 per cent) suggested a higher rate of fishing in this area.

For the most part, spotted seatrout in West Florida do not move great distances. Over 95 per cent of all returned tagged fish were recovered within 30 miles. Regulations of the fishery must be made in consideration of the partially isolated groups of this species. However, a few long movements showed that the populations of the three areas are not completely isolated. The longest movement was about 315 miles. The greatest speed of an individual tagged fish was estimated at about two miles per day.

Growth was estimated from scale marks. Females grow slightly faster than males and also live longer. The oldest age groups were VI for males and VIII for females. Growth rates were similar in Fort Myers and Cedar Key. Growth was slower during the colder months of the year than the warmer months in all three areas.

Spawning begins in May and continues through September in the Fort Myers and Cedar Key areas. The peak of spawning is in the summer. (Auth.)

4656. Rumney, George R. 1961. A SHALLOW WATER TEMPERATURE PROFILE RECORDING SYSTEM. Journal Du Conseil, Vol. XXVI, No. 3, pp. 243-249.

Apparatus for obtaining a semi-continuous record of the temperature profile in shallow water at three levels at a single point of observation is described. The transmitting unit consists of a buoyant tubular spar on which are mounted three stainless steel electric resistance thermometer bulbs connected with a recording potentiometer. The virtually continuous record of values transmitted reveals the manner in which normal thermocline, isothermality, inversion, and heterothermal stratification develop in relation to the occurrence of high and low tides and changing atmospheric situations. The frequency, rate, and amplitude of both periodic and non-periodic fluctuations are clearly portrayed, along with the duration of successive temperature states, and other

details of shallow water temperature experience. (Auth.)

4657. McNeely, Richard L., and Walter T. Pereyra. 1961. A SIMPLE SCREENING DEVICE FOR THE SEPARATION OF BENTHIC SAMPLES AT SEA. Journal Du Conseil, Vol. XXVI, No. 3, pp. 259-262.

A screening box to separate benthic organisms from the sampled substratum was designed and used aboard the exploratory fishing and research vessel "John N. Cobb" during the summer of 1959. Construction details and a physical description are provided. A refinement to improve the efficiency of the described sorting device would be the addition of a sluice under the bottom screen of the box to return silt to the sea rather than onto the deck of the vessel. A major drawback to the sorting method for recovering benthic animals from grab samples is the loss of positional relationships of organisms with respect to their containing media. (Auth.)

4658. Krey, Johannes. 1961. DER DETRITUS IM MEERE. Journal Du Conseil, Vol. XXVI, No. 3, pp. 263-280.

This review shows the important part that detritus plays in the nutrient cycle and particularly its role in the nutrition of the filter-feeders. An account is given of the different methods now available for its quantitative analysis.

In Icelandic waters and in the North Sea detritus has been found to make up 40-90% or more of the seston weight, even during the peak of phytoplankton production. The percentage of detritus is rarely below these values.

In the coastal areas of the North Sea and the Kiel Bight, the proportion of detritus present is always 90% or more. This is due to tidal currents and upwelling which take the detritus from the bottom into midwater.

The central Baltic contains high percentages of detritus (73-90%) although a marked discontinuity layer was present.

A short account is given of a new quantitative method of analysing detritus. Using the Zeiss particle-size-counter and microphotographic techniques the total number and size of living and dead particles in a sample can be determined. Using plankton-equivalent factors, the weight of the total dry substance and the proportion of detritus can be calculated. With this visual method high percentages of detritus were found (52-96%), except in surface samples, where the proportion of detritus was down to 21%. (Auth.)

4659. Bishai, H. M. 1961. THE EFFECT OF PRESSURE ON THE SURVIVAL AND DISTRIBUTION OF LARVAL AND YOUNG FISH. Journal Du Conseil, Vol. XXVI, No. 3, pp. 292-311.

A review of the effect of pressure on larval and young fish is given. Apparatus and methods are described to study the effects of pressure changes on young fish.

Newly hatched herring larvae Clupea harengus L. could live at a pressure of 4 atmospheres. They are neither affected by compression nor by decompression. Thus newly hatched herring larvae can move from deep to shallow water without any ill-effects due to pressure changes even if the water in which they live is supersaturated with gas.

Young plaice Pleuronectes platessa L. are not affected by compression or decompression of at least 2 atmospheres. On decompression the release of gas bubbles was neither observed from the mouth nor from behind the gill covers, nor did gas bubbles form on the body of the fish although the water in which they were living was supersaturated.

The effect of pressure and decompression on salmonids Salmo salar L., Salmo trutta L., and Salmo trutta f. fario depends on the age of the fish. Until the absorption of the yolk-sac alevins can live under pressures as high as 5 atmospheres. They are neither affected by compression nor by decompression. The release of gas bubbles from the mouth or the appearance of gas bubbles on the body was not observed during decompression although the water in which the fish were living was supersaturated. The swimbladder at this stage is not completely developed.

At an age of 56 days, while the fish can stand pressures of two atmospheres (or perhaps more), they are affected by decompression even at a slow rate. Although the swimbladder is well developed, the release of gas bubbles did not take place on decompression and the swimbladder became distended with gas. This was attributed to the incomplete development of the sphincter mechanism which controls the release of gas bubbles from the pneumatic duct.

Salmon and brown trout 98-178 days old die within 24 hours when subjected to any increase of pressure of more than 15 cm Hg. Older fish (272 days), can live under such pressure as well as at higher pressures (4 atmospheres).

The death of young salmonids due to decompression is attributed to the supersaturation of the experimental water with gas. On decompression gas bubbles are separated from the water and attach themselves to the fish. In addition the fish may swallow gas bubbles which block their mouths and the fish die from asphyxia. Death of fish may be due to decompression sickness where gas bubbles are separated from the blood and tissues of the young fish on decompression. The ability of the blood to be supersaturated with gas under pressure may be a character of young fish with swimbladder. (Auth.)

4660. Mitson, R. B., and R. J. Wood. 1961. AN AUTOMATIC METHOD OF COUNTING FISH ECHOES. Journal Du Conseil, Vol. XXVI, No. 3, pp. 281-291.

An automatic system for counting fish echoes close to the seabed is described. This system eliminates loss of information which was inherent in the visual method of counting used hitherto.

Tests made with this system during fishing operations on the West Spitsbergen Banks showed a close relationship between trawl catches and counted fish signals under good weather conditions. (Auth.)

4661. Klawe, W. L. 1961. NOTES ON LARVAE, JUVENILES, AND SPAWNING OF BONITO SARDA FROM THE EASTERN PACIFIC OCEAN. Pacific Science, Vol. XV, No. 4, pp. 487-493.

All evidence indicates that spawning of S. chiliensis takes place in the warmer season off California, Baja California, Peru, and northern Chile. It appears that it should be possible to distinguish between juveniles of S. chiliensis and S. orientalis by means of gill raker counts even at a relatively small size. (Auth.)

4662. Armstrong, F. A. J., and G. T. Boalch. 1961. THE ULTRA-VIOLET ABSORPTION OF SEA WATER. Journal of the Marine Biological Association of the United Kingdom, Vol. 41, No. 3, pp. 591-597.

Measurements of the ultra-violet absorption spectra between 200 and 400 mμ have been made with a spectrophotometer. At short wave-length natural sea water has double the absorbancy of artificial sea water. The difference in samples from shallow depths is ascribed to organic material, of which part may be the 'Gelbstoff' of Kalle. Regional variations have been found, coastal waters having higher U. V. absorptions. A small seasonal effect with an increase in absorbancy in summer in the English Channel has been seen. In deep Atlantic water increased absorption below 235 mμ may be due to its high nitrate concentration. At longer wave-lengths absorbancies were less than in surface waters. Measurements of U. V. absorption may supplement other physical methods of characterizing water masses. (Auth.)

4663. McIntyre, A. D. 1961. QUANTITATIVE DIFFERENCES IN THE FAUNA OF BOREAL MUD ASSOCIATIONS. Journal of the Marine Biological Association of the United Kingdom, Vol. 41, No. 3, pp. 599-616.

The fauna of a muddy area in the northern North Sea (the Fladen ground) is compared with that of a similar area in a Scottish west-coast sea loch (Loch Nevis). These areas were selected because certain similarities in environmental features and in fauna, coupled with their marked difference in biomass, make them particularly suitable for studies of the factors affecting benthic production.

The Fladen ground, depth 140 m, had annual bottom temperatures between 6.31 and 8.22° C and salinities between 35.20 and 35.26 0/00. The deposit was mainly of coarse silt with abundant tests of small Foraminifera. The fauna is redescribed. The standing crop of macrobenthos was 6.42 g/m^2 wet weight.

At the Loch Nevis station, depth 90-110 m, bottom temperatures ranged between 7.04° and 12 12.90° C annually, and salinities between 33.86 and 34.33 0/00. The bottom deposit was mainly of clay, but very large numbers of faecal pellets were present. The fauna - a Foraminifera community characterized by Crithionina granum, is described. The standing crop of macrobenthos was 33.10 g/m^2 net weight.

The meiobenthos in both areas consisted of a permanent population of nematodes, harpacticoids, foraminifers, and ostracods. Young stages of molluscs and polychaetes were also present. There were 1.26 X 10^5 individuals of the meiobenthos per m^2 on Fladen and 1.66 X 10^5 per m^2 in Nevis. The corresponding weights were 1.820 and 2.198 g/m^2 respectively.

The two faunas are compared in detail and their relations with other known communities considered.

Causes of the biomass difference are discussed. Predation by fish is noted as a possible cause but hydrographic differences also may be important. The greater exchange between bottom and surface waters during the summer in Nevis leads to quicker returns of nutrients to the surface and hence to greater primary production which could favour a richer bottom fauna. (Auth.)

4664. Plack, P. A. 1961. VITAMIN A COMPOUNDS IN THE OVARIES OF THE COD, GADUS MORHUA L., FROM THE ARCTIC. Journal of the Marine Biological Association of the United Kingdom, Vol. 41, No. 3, pp. 617-630.

Cod Gadus morhua L. from the Arcto-Norwegian stock that spawns off northern Norway were caught at various times during their gonadal maturation cycle over a period of 16 months. The ovaries were removed and either fixed for histological work or deep-frozen for the determination of vitamin A compounds.

The ovaries were inactive from June to September. Maturation began in late September-October and fully ripe eggs were present in February-March, the range of sizes being 500-650 μ. After spawning there was a period of resorption and regeneration, until May, followed by the quiescent summer period.

During maturation, the weight of the ovaries increased and the percentage of dry matter rose from about 16 to 29%; the total amount of vitamin A aldehyde, vitamin A esters and alcohol, carotenoids and lipids in the ovaries also increased, though the concentrations of the carotenoids and vitamin A esters + alcohol on a dry-matter basis fell. Vitamin A aldehyde was only found in maturing ovaries and in February, just before spawning, the weight ratio of aldehyde to esters + alcohol was about 10 to 1. The other substances were present in resting ovaries. The appearance of aldehyde in the ovaries occurred when there was histological evidence for the onset of vitellogenesis. (Auth.)

4665. Nicol, J. A. 1961. PHOTOMECHANICAL CHANGES IN THE EYES OF FISHES. Journal of the Marine Biological Association of the United Kingdom, Vol. 41, No. 3, pp. 695-698.

In the common sole the retinal pigment moves towards the external limiting membrane in the light, and towards the chorioid in the dark. Usually cones shorten in the light and elongate in darkness, but there are many exceptions, movement in the expected direction often being partial or wanting. In the light-adapted eye the pigment extends along the processes of the pigment cells and screens the outer segments of the rods. The pigment extends to the ellipsoids of the retracted cones, sometimes

reaches the external limiting membrane, and comes to lie between the outer segments of the cones which are screened, to some extent from one another. Movements of pigment and cones occur in $\frac{1}{2}$-1 h.

No consistent difference was noted in pigment and cones of fish killed at 12.00 h and fish killed at 24.00 h, both groups being dark-adapted. The reverse experiment, of keeping fish in light by day and night, was not tried.

In dark-adapted eyes the pigment is sometimes slightly expanded in the ventral retina when it is fully retracted in the dorsal retina. Conversely, in light-adapted eyes, the pigment is sometimes denser and extended to a greater degree in the ventral retina compared with the dorsal retina. Also movement of cones tends to be retarded to a greater degree in the ventral retina. These differences may be connected with polarity in the eye. (Auth.)

4666. Miller, P. J. 1961. AGE, GROWTH, AND REPRODUCTION OF THE ROCK GOBY GOBIUS PAGANELLUS L., IN THE ISLE OF MAN. Journal of the Marine Biological Association of the United Kingdom, Vol. 41, No. 3, pp. 737-768.

Age, growth and reproduction of the intertidal teleost, Gobius paganellus, has been investigated in the Isle of Man from March 1959 to September 1960. Samples were obtained by poisoning shore pools with a rotenone emulsion.

Age was determined by examination of otoliths where a translucent annual ring is laid down in spring. Although the potential life span is at least 10 years, immature fishes of the first two age-groups constitute most of the population. An onshore breeding migration is postulated. An empirical survival curve indicates a high mortality rate during the first two years of life. Instances of predation on G. paganellus are given.

Growth in length is logarithmic, with marked decrease in growth rate from about the age of sexual maturity. During the year, growth occurred from June to October. Maximum standard lengths recorded were 92.5 mm (female) and 90.0 mm (male).

The overall sex ratio of females to males was 1:1.326; this predominance of males persisted through the age-groups. The reproductive organs are briefly described, and a classification of gonad maturation is proposed. The breeding season lasted from mid-April to mid-June. Sexual maturity was reached at the end of the second or third year of life. Smallest ripening individuals found were 48.5 mm (female) and 50.5 (male). Fecundity increased with body size. Eggs were deposited on stones in shore pools and guarded by the male. Postlarvae occurred in pools from the beginning of July, and the first demersal individuals from August. Size-frequency distribution of oocytes in the ovary indicates that at least two broods may be produced in a single breeding season.

In maximum size, longevity, and age at maturity, G. paganellus differs from other European gobies so far studied. It is suggested that a similar life history is exhibited by other British species of Gobius. The short breeding season of G. paganellus in the Isle of Man is held to be a result of proximity to the northern limit of distribution of this species. Examples of this phenomenon in other teleosts are provided. The significance of pre-ovulatory corpora lutea in the ovary of G. paganellus is briefly is briefly discussed. (Auth.)

4667. Rozin, Paul N., and Jean Mayer. 1961. THERMAL REINFORCEMENT AND THERMOREGULATORY BEHAVOIR IN THE GOLDFISH, CARASSIUS AURATUS. Science, Vol. 134, No. 3483, pp. 942-943.

Goldfish in a warm environment can cause a small drop in the temperature of their environment by pressing a lever. The fish regulate the temperature of their environment, keeping the temperature between 33.5° and 36.5°C most of the time. (Auth.)

4668. Harrington, Robert W., Jr. 1961. OVIPAROUS HERMAPHRODITIC FISH WITH INTERNAL SELF-FERTILIZATION. Science, Vol. 134, No. 3492, pp. 1749-1750.

Adults of Rivulus marmoratus (Cyprinodontidae) contained eggs when dissected or laid eggs when kept alive. They invariably oviposited solo, emitting eggs in various developmental stages. Both juvenescent and senescent fish have functional ovotestes. Progeny (F_3) were obtained via a selfed great grandparent, grandparent, and parent, the last two in isolation ab ovo. (Auth.)

4669. Saunders, Richard L. 1961. THE IRRIGATION OF THE GILLS IN FISHES. Canadian Journal of Zoology, Vol. 39, No. 5, pp. 637-653.

A technique which does not interfere with normal respiratory movements was developed for measuring the changes in hydrostatic pressure in the oral and opercular cavities of fish breathing at various intensities. This consisted of inserting polyethylene tubing of small diameter through the cleithrum into the opercular cavity and through the rostrum into the oral cavity. These cannulae were connected with manometers which were used together with optical lever systems to record the time course of changes in hydrostatic pressures in the two components of the branchial pump.

In the white sucker, brown bullhead, and carp the flow of water over the gills is nearly continuous. There are only brief periods when the pressure in the opercular cavities exceeds that in the oral cavity and therefore only brief reversals in flow in which some water may be returned over the gills. The slits between adjacent hemibranchiae of neighboring gills were observed to open rhythmically during moderate and heavy breathing. This observation is contrary to the thesis of many workers that water bathing the gills flows only through the minute pores between adjacent lamellae. Such opening of the gill slits may have a significant effect in the operation of the gills. (Auth.)

4670. Gunter, Gordon, L. L. Sulya, and B. E. Box. 1961. SOME EVOLUTIONARY PATTERNS IN

FISHES' BLOOD. The Biological Bulletin, Vol. 121, No. 2, pp. 302-306.

A study was made, by electrophoretic techniques, of the plasma proteins of 26 species of elasmobranch and teleostome fishes from the northern Gulf of Mexico.

A general increase was found in the amount of plasma. This condition of analbuminemia also held true for all the gars and half of the Clupeidae studied; it generally disappeared in the more specialized fishes, but not entirely, and was found in two species of the Perciformes. There was a gradual increase in the number of globulin fractions of the plasma, from lower to higher fishes, among the Orders of fishes, which did not always hold true at species levels.

Closely related species could be distinguished by the presence or absence and varying amounts of plasma proteins, but there were exceptions and certain species in the same family could only be differentiated doubtfully on that basis.

The plasma proteins of the fishes examined showed a trend of increasing complexity from the generalized to the more specialized fishes.

The content of the chief electrolytes, Na, K and Cl, in the plasma of marine sharks was found to be much higher than in teleosts, in confirmation of earlier workers.

Total cholesterol in the plasma of sharks and gars was found in the same range as in mammals, but in the remaining teleost fishes it was a great deal higher.

Relations between cholesterol and plasma proteins in the blood of fishes resemble pathological conditions in mammals, including man. (Auth.)

4671. Barlow, George W. 1961. INTRA- AND INTERSPECIFIC DIFFERENCES IN RATE OF OXYGEN CONSUMPTION IN GOBIID FISHES OF THE GENUS GILLICHTHYS. The Biological Bulletin, Vol. 121, No. 2, pp. 209-229.

Rate of oxygen uptake was determined for moist fish in a Warburg apparatus. Fish acclimated to 10° were tested at 10° and 17°; those acclimated to 24° were tested at 24° and 31°. Five populations of G. mirabilis were investigated (San Francisco Bay in central California, Los Penasquitos in southern California, San Felipe in the northern Gulf of California, Puerto San Carlos in the central Gulf, and the Salton Sea). One population of G. seta (from the upper Gulf) was studied at 24°.

Rate of oxygen consumption per unit weight was plotted against body weight. The regression coefficient, b, differed between populations for G. mirabilis though not in an interpretable fashion. The value of b was low at 10° and 17° (-0.14 and -0.35), and high at 24° and 31° (-0.45 and -0.63). The slopes were much lower for G. seta at 24° and 31° (-0.29 and -0.26) than for G. mirabilis.

The mean rates of oxygen uptake were different for the populations of G. mirabilis at all temperatures except 24°. The average rate for G. seta at 24° was lower than that for G. mirabilis, but the rates were about the same for both species at 31°.

The temperature coefficients, Q_{10}, varied from population to population of G. mirabilis in what seemed to be a pattern. The coefficients were lower in groups from the Gulf of California at almost all temperature intervals. Within the Pacific Coast and Salton Sea populations, the Q_{10}'s for the northern population were highest at the low acclimation temperature, and lowest at the high acclimation temperature. For all groups, the Q_{10}'s were highest when cold-acclimated (2.2 to 2.8), and lowest when warm-acclimated (1.4 to 1.6). The coefficient for warm-acclimated G. seta was high (2.0).

There was no apparent difference in temperature coefficients between large and small G. mirabilis for acute temperature changes. The smaller fish manifested appreciably higher Q_{10}'s than did the larger fish, however, when rates were compared after acclimation.

The degree of intra- and interspecific differences in the nature of the oxygen consumption was roughly of the same order of magnitude as the morphological differences reported in another article. (Auth.)

4672. Nose, Yukio. 1961. AN ANALYSIS OF THE PETERSEN-TYPE FISH POPULATION ESTIMATE. Bulletin of the Japanese Society of Scientific Fisheries, Vol. 27, No. 8, pp. 763-773.

Assuming that the diminution of tags which involves the extra natural mortality of the tagged fish and the loss of tags, occurs at a constant rate throughout the period of experimentation, the extent of overestimation in the PETERSEN-type estimate, caused by the above factors was analyzed. The calculation showed that the bias of estimate increases as time passes and tends to approach the maximum limit which is determined by the ratio of the tag diminution coefficient to the total mortality coefficient.

In order to eliminate this bias, a method based on the series of sample tag ratios obtained for regular intervals after liberation, was deduced.

The validity of this method was ascertained by the bead drawing experiment and comparing the results obtained by this method with those of simple PETERSEN method and the BEVERTON method, the advantages and disadvantages were discussed. It was also shown that the size of natural mortality coefficient may roughly be estimated by using the Author's method and the BEVERTON method together. (Auth.)

4673. Kojima, Shumpei. 1961. STUDIES ON FISHING CONDITIONS OF DOLPHIN, CORYPHAENA HIPPURUS L., IN THE WESTERN REGION OF THE SEA OF JAPAN. III. ON FOOD CONTENTS OF THE DOLPHIN. Bulletin of the Japanese Society of Scientific Fisheries, Vol. 27, No. 7, pp. 625-630.

The food contents of 1,103 individuals, captured under the dipped wood at the offing of Hamada, Shimane Prefecture, from July, 1955, to October, 1959, were examined.

The contents of the alimentary canal have been

classified into a great many different kinds, which are Pisces, Crustacea, Mollusca, Coelenterate and Algae. The first is particularly dominant in frequency of appearance and in wet weight, amounting to nearly 90%.

The alimentary canal contents are limited to the creatures of surface layer, and it has been found that there is the limit on body length of those of median layer, Sardinops melanosticta, Trachurus japonicus and so on.

Body length of food fishes varies from 1 cm to 34 cm, but this may be divided into two discontinuous groups (2 - 4 cm and 10 - 15 cm).

The median sized food fishes (10 - 15 cm) are most prominent in frequency of appearance and in wet weight.

Larvae of Monacanthidae, Upeneus bensai, Engraulis japonica and Oplegnathns fasciatus have been found abundantly in young forms, which had been swallowed by dolphins. (Auth.)

4674. Taguchi, Kisaburo. 1961. ON THE GROWTH RATE OF CATCHABLE SALMON IN OFFSHORE WATERS. Bulletin of the Japanese Society of Scientific Fisheries, Vol. 27, No. 7, pp. 637-644.

In the tagging experiment for salmon in the North Pacific, the body length of tagged salmon measured both at the time of its tagging and recovery. The difference between these is considered to be the growth in the period of migration.

Assuming that the growth of salmon in the period be expressed as $l_t = l_e^{Kt}$, the value of K (instantaneous growth rate) could be estimated by this formula. (l_t; Body length at the time of recovery, l; Body length at the time of tagging, t; Period by number of day).

The data used here are the results of tagging experiments carried out in the waters of Aleutian Is. from 1956 to 1958 by the U. S. The value of K of mature salmon is larger than that of immature, and the K of pink salmon is larger than those of red salmon and chum salmon. (Auth.)

4675. Penczak, Tadeusz. 1961. SEROLOGICAL RELATIONSHIPS BETWEEN THE NINE-SPINED AND THE THREE-SPINED STICKLEBACK. Nature, Vol. 192, No. 4803, pp. 673-674.

The serological distance between Gasterosteus aculeatus L. and Pungitius pungitius (L.) is great and it amounts to 56.3 percent.

The fact that identical results are found for the same species taken from different fishing places supports the application of serology to taxonomic investigations The non-typical reaction with antigen of young three-spined sticklebacks is also in agreement with work already published. (Auth.)

4676. Bonn, Edward W. 1961. LAKE TEXOMA WHITE BASS TAGGING STUDY. Texas Game and Fish Commission, 28 pp.

A tagging study of white bass Roccus chrysops was conducted on Lake Texoma from November 1954, until December 1959, and 3,254 fish were marked with Petersen disk tags. Both urethane and MS222 were effective sedatives for the fish before attaching the tags with nylon or stainless steel wire. During the five-year period, 348 (10.7 percent) fish were retaken, with April and May the peak return months each year. Commercial fishermen caught many fish, but were uncooperative in reporting information. Minnows were the bait used for 46 percent of the returns, while 21 percent were taken on artificial lures and 20 percent by nets. The interval of freedom of the tagged fish varied from 0 to 773 days, with 89 days the average. Their movement varied from less than 50 yards to as much as 200 miles up a tributary river, with an average movement of 10.6 miles. The fastest rate of travel was 6.9 miles per day in the river and 3.25 miles in the lake. The most unusual movement was that of fish which traveled through the Denison Dam Powerhouse and were caught from the river below. There appears to be a correlation between the movement of these fish from the lake and the type and amount of water discharged into Red River. In all, 53 fish or 15 percent of the returns, were caught below the dam after making this unusual trip. There was no indication that fish move into the lake from the river below the dam. Information gained on length and weight of returned fish was not a good indication of the growth of Texoma white bass. Based on a small sample of scale returns, the fish that continued to grow added an annulus some time in late April. Those that did not add a year mark were not free in mid-April or did not increase in size and weight. Recommendations are made to liberalize the regulation for taking white bass and to revise the laws for removing rough fish from Lake Texoma. (Auth.)

4677. Springer, Victor G., and Andrew J. McErlean. 1961. SPAWNING SEASONS AND GROWTH OF THE CODE GOBY, GOBIOSOMA ROBUSTUM (PISCES: GOBIIDAE), IN THE TAMPA BAY AREA. Tulane Studies in Zoology, Vol. 9, No. 2, pp. 77-85.

Egg diameter measurements indicate that Gobiosoma robustum spawned from early spring to early summer and from late summer to fall during 1960 in the Tampa Bay area. The middle non-spawning period occurred during highest temperatures. Standard length frequency progressions support egg diameter data and also indicate that G. robustum is an annual species.

Sex ratios are usually about 1:1. Males achieve a larger size than females. Females may mature at 14.6 mm. standard length when only a few months old. (Auth.)

4678. Clemens, Harold B. 1961. THE MIGRATION, AGE, AND GROWTH OF PACIFIC ALBACORE, THUNNUS GERMO, 1951-1958. State of California Department of Fish and Game, Fish Bulletin No. 115, 128 pp.

During January 1952, California Department of Fish and Game marine biologists developed history's first successful tuna tag. It resembles a piece of spaghetti and has been employed as a

research tool for studying the populations of important tuna species. Using these tags Department scientists discovered: that albacore migrate northward up the west American coast averaging at least six nautical miles per day; that they perform a transpacific migration between the American mainland and the Hawaiian Islands and Japan; that their growth rate is relatively rapid, averaging seven pounds per year for the catch-dominating 13-pound fish; that the natural size groups in the fishery are successive year classes; that individuals and perhaps the same schools return to the American fishing grounds during several seasons; and that there is but one population in the North Pacific.

In addition Department scientists have determined the ages of albacore by studying rings on the scales; have obtained valuable data on the time and place of albacore spawning; and have determined their size at maturity.

Data obtained from research cruises and specially designed fishermen's logbooks disclosed that albacore abundance is greatest where sea-surface temperatures are 60-68 degrees F. This information led to our discovery of the albacore coastward migration routes and the successful prediction of vast migration route changes in 1958, 1959, and 1960. (Auth.)

4679. Hallock, Richard J., William F. Van Woert, and Leo Shapovalov. 1961. AN EVALUATION OF STOCKING HATCHERY-REARED STEELHEAD RAINBOW TROUT, SALMO GAIRDNERII GAIRDNERII, IN THE SACRAMENTO RIVER SYSTEM. State of California Department of Fish and Game, Fish Bulletin No. 114, 74 pp.

In all, 859 steelhead were spawned at the hatchery and produced 13,055 sea-run adult returns, a return of 15 adults for each fish spawned at the hatchery. In natural reproduction, generally only one is produced for each steelhead in the run.

Stocking of yearling steelhead in the Sacramento River at Princeton resulted in sufficient sea-run adult returns to the hatchery on Battle Creek to continue a moderate artificial stocking program and at the same time to produce some natural dispersion of hatchery steelhead throughout the upper Sacramento River system.

The costs of producing yearling steelhead varied from three cents to eighteen cents each and averaged six cents. Since a return of only 2 percent as adults was realized from the average group of yearlings released, the cost of producing each sea-run steelhead return to the upper Sacramento was about $3.00.

The sport catch was based primarily on angler tag returns. Without correcting for tags which were not sent in, the figure showed that an average of about 30 percent of the run was harvested each season, and also that there was an increase in the catch from 20.1 percent in 1953 to 36.5 percent in 1958. It was estimated that about 20 percent of the tags taken by anglers were not returned. Correcting for a 20 percent nonreturn of tags, the anglers harvested 45.6 percent in 1958 instead of 36.5 percent.

On the basis of uncorrected tag returns, the release of 663,240 yearlings eventually produced 3,882 sea-run hatchery steelhead in anglers' creels. Thus, whereas 2 percent of the average yearlings released returned to the upper Sacramento as adults, only 0.6 percent ended in anglers' creels. On the average, it cost $10 to put a sea-run hatchery steelhead in the creel. By correcting this figure for a 20 percent nonreturn of tags, the average cost of putting an adult steelhead in the creel was $8.00.

Creel censuses were conducted to determine average catch per angler hour, length of the average angler day, and county of residence of anglers, and to see as many steelhead as possible in order to help establish the tagged and marked fish ratios in the upper Sacramento. From 1954 through 1958, over 10,000 steelhead anglers were interviewed. The average angler day was determined to be about 4.1 hours. The average annual number of steelhead angler days spent on the upper Sacramento from 1954 through 1958 was 21,597. On the average, fishermen from 40 of California's 58 counties fish for steelhead in the upper Sacramento River annually. Ninety-six percent come from three general areas in California: (1) Sacramento Valley, (2) San Francisco Bay and Sacramento-San Joaquin Delta, and (3) southern California.

A sport fishery is worth at least the amount of money that anglers spend in pursuit of it. The minimum average annual expenditure by Sacramento River steelhead fishermen was a little under $390,000 from 1954 through 1958. The average steelhead fisherman spends almost $40 for each steelhead landed. (Auth.)

4680. Thompson, J. R., and Stewart Springer. 1961. SHARKS, SKATES, RAYS, AND CHIMAERAS. U. S. Fish and Wildlife Service, Bureau of Commercial Fisheries Circular 119, 19 pp.

A general introduction to the class Chondrichthyes is presented. Material included encompasses, in broad terms, characteristics of the class and of its components. General statements on reproduction, numbers and general distribution, size, food and feeding, sensory perception, structural adaptions to specific modes of life, and relation to man are included. A short, annotated list of references directs the reader to more specific and detailed sources for further study. (Auth.)

4681. McFadden, James T. 1961. A POPULATION STUDY OF THE BROOK TROUT, SALVELINUS FONTINALIS. Wildlife Monographs, No. 7, 73 pp.

In the entire stream, September populations of brook trout ranged from 936 to 1,796 fish per acre and from 49 to 99 pounds per acre, whereas April brook trout populations ranged from 343 to 1,003 fish per acre and from 33 to 75 pounds per acre. Rainbow trout populations ranged from 24 to 109 fish per acre and from 2 to 9 pounds per acre.

Trout more than 4 summers old were very scarce.

Some movement of fish was detected, but the studies, of an inconclusive nature, suggested that, in terms of the total population, movement was not extensive.

Unweighted mean-annual mortality, measured from one September to the next, was 79 percent for Age Group 0, 90 percent for Age Group I, 96 percent for Age Group II, 91 percent for Age Group III, and 75 percent for Age Group IV.

Average lengths attained by brook trout in September were about 4.0 inches for Age Group 0, 7.5 inches for Age Group I, 9.5 inches for Age Group II, 12 inches for Age Group III, and 14 inches for Age Group IV.

Angling pressure ranged from 414 to 495 hours per acre for the entire stream during the approximately 131-day seasons. The catch of all trout ranged from 192 to 387 fish per acre and from 32 to 62 pounds per acre. The sex ratio of the catch is about 50 percent females for yearlings, and 73 percent females for 2-year-old fish. Exploitation rates ranged from 19 percent to 75 percent in individual stream sections, and from 32 percent to 65 percent for the entire stream. (Auth.)

4682. Clark, John R., and Frank A. Dreyer. 1961. NEW ENGLAND HADDOCK FISHERY BIOSTATISTICS—1956. U. S. Fish and Wildlife Service Special Scientific Report--Fisheries No. 375, 89 pp.

A statistical review of the haddock fishery of New England banks (Subarea 5 of the International Commission for the Northwest Atlantic Fisheries) is presented for the 1956 haddock year. Estimates of total fishery removals are given for scrod and large haddock, both landed and discarded at sea, by month and area of capture. The estimated age and length compositions of the total haddock discard for 1956 are given. Age and length compositions are estimated by month for haddock landed from Georges Bank (ICNAF Subdivision 5Z) and by season for haddock landed from the Gulf of Maine (Subdivision 5Y). Fishing effort and abundance estimates are given for Georges Bank by month. (Auth.)

4683. Anderson, William W., Joseph E. Moore, and Herbert R. Gordy. 1961. WATER TEMPERATURES OFF THE SOUTH ATLANTIC COAST OF THE UNITED STATES, THEODORE N. GILL CRUISES 1-9, 1953-54. U. S. Fish and Wildlife Service Special Scientific Report--Fisheries No. 380, 208 pp.

Water temperature data obtained during nine cruises of the M/V Theodore N. Gill off the south Atlantic coast of the United States are further processed and organized in a much more usable and readily available form. Surface water temperatures by season are presented graphically. (Auth.)

4684. Tagatz, Marlin E. 1961. TOLERANCE OF STRIPED BASS AND AMERICAN SHAD TO CHANGES OF TEMPERATURE AND SALINITY. U. S. Fish and Wildlife Service Special Scientific Report--Fisheries No. 388, 8 pp.

Experiments were conducted to determine the effect of abrupt temperature and salinity changes on adult and juvenile striped bass Roccus saxatilis and American shad Alosa sapidissima. Transfers were made at specific temperature and salinity differences over the range 45° to 80° F. and 10 to 35 0/00. Adult and juvenile striped bass were tolerant to transfers between salt and fresh water at most temperature differences. Adult shad were tolerant to transfers from fresh to salt water and displayed some tolerance to transfers from salt to fresh water at limited temperature differences. Juvenile shad survived salinity and temperature differences from salt to fresh water, but did not survive these differences from fresh to salt water. (Auth.)

4685. Forney, John L. 1961. GROWTH, MOVEMENTS AND SURVIVAL OF SMALLMOUTH BASS MICROPTERUS DOLOMIEUI IN ONEIDA LAKE, NEW YORK. New York Fish and Game Journal, Vol. 8, No. 2, pp. 88-105.

Smallmouth bass were tagged and released prior to the fishing season from 1954 to 1958. Most recoveries of tagged bass were made near the tagging site, indicating localized populations. When bass were moved from the netting site to distant release points the majority of the displaced bass returned to their home area.

Growth of bass in Oneida Lake compared favorably with that of bass in other northern lakes. Bass in the Constantia population average 9.8 inches at age III, 12.3 at age IV, 13.5 at age V and 14.7 at age VI. Small but consistent differences in growth rate were observed among three Oneida Lake bass populations which were studied.

Geometric mean survival for age V to X bass, based on a catch curve, was 0.55. Annual survival rates estimated from tag returns in successive years were 0.48 in 1955, 0.42 in 1956 and 0.82 in 1957. For these three years minimum rates of exploitation were 0.18, 0.21 and 0.05. Assuming the instantaneous natural mortality rate (q) is constant, it is shown that $i = C\,(u' \frac{i}{a}) + q$ may yield an approximate estimate of q from paired values of total mortality (a) and minimum rates of exploitation (u'). An instantaneous natural mortality rate of 0.08 was calculated for bass in Oneida Lake. (Auth.)

4686. Hamilton, W. F., Jr. 1961. LATE FALL, WINTER AND EARLY SPRING FOODS OF 141 OTTERS FROM NEW YORK. New York Fish and Game Journal, Vol. 8, No. 2, pp. 106-109.

The contents of stomach and intestines of 141 otters from the Adirondack region of New York, taken from late fall to early spring, were analyzed to determine food habits. Fish occurred in 70 percent of the specimens, being represented by minnows, 35.5 percent; sunfish and black bass, 12.1 percent; perch, 9.3 percent, suckers, 6.4 percent;

trout, 5 percent; catfish, 2.1 percent; sculpins, 2.1 percent; mudminnows, 1.4 percent; pickerel, 0.7 percent and undetermined fish, 12.8 percent. Crayfish were eaten by 34.7 percent, frogs and their tadpoles by 24.8 percent, and aquatic insects occurred in 13.5 percent of the otter. Mammals, including two instances of muskrats, occurred in 4.3 percent while one otter had eaten a bird. (Auth.)

4687. Lipschuetz, M., and A. L. Cooper. 1961. TOXICITY OF 2-SECONDARY-BUTYL-4,6-DINITROPHENOL TO BLACKNOSE DACE AND RAINBOW TROUT. New York Fish and Game Journal, Vol. 8, No. 2, pp. 110-121.

The toxicity of 2-secondary-butyl-4,6-dinitrophenol to fish life, using western blacknose dace and rainbow trout as test fish, was determined by a flow-through technique. The tests with the blacknose dace were carried out at 70° F. and those with the trout at 65° F. The values for the 24-hour median lethal concentration (24-hour LD_{50}) were: for blacknose dace, 0.24 p.p.m. at pH 8.0; for rainbow trout, 0.30 p.p.m. at pH 8.0 and 0.073 p.p.m. at pH 6.9. The concentrations required to produce complete mortality for exposure periods up to about 4 hours were also investigated. The data indicate, for rainbow trout, that when the pH changed from 6.9 to 8.0 the concentration required to bring about any fixed mean time to death had to be increased about five-fold. (Auth.)

4688. Snieszko, S. F. 1961. HEPATOMA AND VISCERAL GRANULOMA IN TROUTS. New York Fish and Game Journal, Vol. 8, No. 2, pp. 145-150.

All vertebrates are subject to numerous neoplastic diseases. In some instances the incidence of neoplastic diseases is very high as in the case of hepatoma in hatchery-raised rainbow trout. In hatchery-raised brook trout a visceral granuloma seems to be equally frequent. At the present time one can only speculate on the causes of these diseases, but circumstantial evidence seems to incriminate genetic makeup nutrition, and metabolism as the most likely contributing factors in both diseases. (Auth.)

4689. Gard, Richard. 1961. CREATION OF TROUT HABITAT BY CONSTRUCTING SMALL DAMS. Journal of Wildlife Management, Vol. 52, No. 4, pp. 384-390.

Small dams were constructed in the headwaters of Sagehen Creek, California, in an attempt to create a habitat suitable for brook trout. The study was initiated in July 1957 and terminated in January 1961. Following erection of the dams, 128 brook trout from a population lower in the creek were introduced. Survival rates of the trout were high, averaging 50 percent for the three study years. Spawning was successful and a population of resident trout was well established by 1960. Headwater trout were in better condition than trout from lower elevations despite lower temperatures in the headwaters.

Introduced trout were successful in the headwaters because ponds provided necessary living space and shelter, and initial trout density was low. Construction of small dams accompanied by introduction of wild brook trout into headwaters of other Sierra Nevada streams is suggested as a means of establishing trout populations and trout fishing. (Auth.)

4690. Fortmann, H. R., A. S Hazzard, and A. D. Bradford. 1961. THE RELATION OF FEEDING BEFORE STOCKING TO CATCHABILITY OF TROUT. Journal of Wildlife Management, Vol. 25, No. 4, pp. 391-397.

Prior feeding reduced the catchability of trout. As an average of all species, days, and experiments, the comparative values for fed vs. starved trout caught were 29 and 42 percent.

The difference between starved and fed trout diminishes with time. This was probably due to the fact that feeding in the raceway was very restricted, so that fed trout essentially became starved trout and behaved accordingly.

As an average of all species, the available fed trout caught increased from 16 percent on the first day to 37 percent on the third day. At the same time the percentage of starved trout caught increased only from 40 to 45 percent. This suggests that increasing the starvation level of trout does not produce a corresponding level of catchability. (Auth.)

4691. Paloheimo, J. E. 1961. STUDIES ON ESTIMATION OF MORTALITIES. I. COMPARISON OF A METHOD DESCRIBED BY BEVERTON AND HOLT AND A NEW LINEAR FORMULA. Journal of the Fisheries Research Board of Canada, Vol. 18, No. 5, pp. 645-662.

A method, described by Beverton (1954) and Beverton and Holt (1956 and 1957), giving estimates of the natural mortality rate, M, and the catchability coefficient, q, from catch at age and effort data, is examined. This method requires 4 to 5 iterations to arrive at the estimates We have derived approximate solutions for q and M in a closed form. This makes the laborious iterations unnecessary, and gives virtually the same values as arrived at by iterations.

The effectiveness of the iterative Beverton and Holt method is evaluated by calculating q and M in 30 hypothetical examples. A new and simple (linear formula) method for estimating q and M is derived. Application of the new method to these 30 examples resulted in a 48% reduction in the standard deviation of q and a 45% reduction in that of M. The new method is in part the same as one suggested by Gulland, Beverton, and Holt (Beverton et al., MS, 1958; Holt, MS, 1959) to arrive at initial values in their short-cut (iterative) method of estimating the mortality rates. Thus we show that these initial values are actually better estimates than the final values arrived at by the iteration.

Neither the Beverton and Holt method nor the linear formula give necessarily unbiased estimates;

the bias depends on the types of variability in the data.

To arrive at non-biased, least squares estimates would require ancillary information not usually available on the distributions of the three variates: catch at age, effort, and catchability coefficient. (Auth.)

4692. Norden, Carroll R. 1961. COMPARATIVE OSTEOLOGY OF REPRESENTATIVE SALMONID FISHES, WITH PARTICULAR REFERENCE TO THE GRAYLING, THYMALLUS ARCTICUS AND ITS PHYLOGENY. Journal of the Fisheries Research Board of Canada, Vol. 18, No. 5, pp. 679-791.

The purpose of this study is to describe the morphology, particularly the osteology, of the grayling, Thymallus arcticus, in relation to that of the other salmonid fishes, in order to assess the phylogenetic position of the grayling and to synthesize the natural classification of the Salmonidae.

Prior classifications of the salmonids have arranged them into one, two, or three families. As herein visualized, the family Salmonidae contains those salmonoid fishes that have three upturned caudal vertebrae. They are divided into three subfamilies: Salmoninae, the trouts and salmons, with an orbitosphenoid bone and a suprapreopercular bone, a basibranchial plate, teeth on the maxilla, no dermosphenotic bone, and parietals separate at the midline; Thymallinae, the graylings, with no orbitosphenoid, suprapreopercle or basibranchial plate, a dermosphenotic bone, teeth on the maxilla, and parietals meeting at the midline; and Coregoninae, with orbitosphenoid and dermosephonotic bones, no supraperopercle, no teeth on the maxilla, and parietals meeting at the midline.

The grayling possesses only two invariable morphological differences from other salmonids. These are the absence of an orbitosphenoid bone and the presence of seventeen or more dorsal fin rays. In other characters, there is overlap with one or the other subfamilies.

Three osteological characteristics are thought to be more fundamental than the others: the toothless maxilla in the Coregoninae, the lack of an orbitosphenoid in the Thymallinae, and the separation of the parietals by the supraoccipital in the Salmoninae. Each character is distinctive for only one subfamily, it being common to the other two. The complete bony and cartilaginous skeletal system of the grayling is illustrated, as are many osteological features of the trouts and whitefishes.

Within the subfamily Salmoninae, 5 genera (Brachymystax, Hucho, Salvelinus, Salmo, and Oncorhynchus) are recognized and defined. The Thymallinae consists of a single genus Thymallus with 4 species. Three genera of Coregoninae are recognized: Prosopium, Coregonus, and Stenodus. The discovery that Prosopium has a basibranchial plate, taken together with previously known characters, justifies recognition of generic rank for this group. The group commonly ranked as a genus Leucichthys does not display enough difference to warrant such segregation and is synonymized with the genus Coregonus. Stenodus is found to have distinctive characters not heretofore noted and may rank as a genus separable from but related to Coregonus. (Auth.)

4693. McPhail, J. D. 1961. A SYSTEMATIC STUDY OF THE SALVELINUS ALPINUS COMPLEX IN NORTH AMERICA. Journal of the Fisheries Research Board of Canada, Vol. 18, No. 5, pp. 793-816.

Sympatric populations of Salvelinus malma and Salvelinus alpinus from Karluk and Fraser Lakes, Kodiak Island, Alaska, were compared using the discriminant function analysis. The analysis indicated that hybridization between S. malma and S. alpinus rarely, if ever, occurs in these lakes. Therefore, S. malma and S. alpinus are considered distinct species. Data on 507 S. malma and 411 S. alpinus from 77 localities suggest at least two distinct forms of both S. malma and S. alpinus in North America. Speculations are made on the origin and evolution of S. malma and S. alpinus. (Auth.)

4694. Paulik, Gerald J. 1961. DETECTION OF INCOMPLETE REPORTING OF TAGS. Journal of the Fisheries Research Board of Canada, Vol. 18, No. 5, pp. 817-832.

A table is presented which gives the total number of tags that must be recovered in order to have a prescribed probability of discovering non-reporting by fishermen of a certain percentage of recaptured tags when a portion of the catch or of the effort is inspected by special observers. The table gives the required sample sizes for probabilities of detection of 0.50, 0.80, 0.90, 0.95, and 0.99 at various levels of catch inspection. The table may also be used to find the sample size needed to detect with prescribed probability a differential mortality between two identifiable groups of fish whose initial numbers are known. A number of examples of the use of the table are included. (Auth.)

4695. Chung-Wai Ho, F., and W. E. Vanstone. 1961. EFFECT OF ESTRADIOL MONOBENZOATE ON SOME SERUM CONSTITUENTS OF MATURING SOCKEYE SALMON, ONCORHYNCHUS NERKA. Journal of the Fisheries Research Board of Canada, Vol. 18, No. 5, pp. 859-864.

Blood changes associated with egg production or estrogenization in other egg-laying vertebrates have been obtained in adult sockeye salmon. The blood picture of male salmon following estrogenization approaches that of sexually maturing females. Exogenous estrogen superimposed on endogenous gonadal hormones in maturing female salmon enhances the serum changes associated with egg formation. (Auth.)

4696. Ketchen, K. S. 1961. OBSERVATIONS ON THE ECOLOGY OF THE PACIFIC COD, GADUS

MACROCEPHALUS, IN CANADIAN WATERS. Journal of the Fisheries Research Board of Canada, Vol. 18, No. 4, pp. 513-558.

In Canadian waters, Pacific cod are close to the southern limit of their range and appear to inhabit depths where temperatures are between 6° and 9° C. Seasonal variations in depth distribution are not as pronounced as those in the northwestern Pacific where there are much greater variations in the seasonal cycle of temperature.

Relatively high temperature experience in Canadian waters appears to be responsible for a more rapid initial growth rate (instantaneous rate, g = 1.99 between ages I and II; 0.64 between ages II and III, decreasing to 0.19 between ages IV and V) and a much shorter life span than elsewhere. Estimates of L_∞, range from 0.56 to 0.71.

Maturity is reached at two to three years of age - several years earlier than in colder regions of the North Pacific - and estimates of instantaneous total mortality rate range from 1.27 to 1.77 for fish of commercial size. Although these are probably overestimates, it is nevertheless apparent that total mortality rate is very high and that a large share is due to natural causes. Instantaneous natural mortality rate possibly exceeds 0.9. (Auth.)

4697. Bell, Gordon R. 1961. TWO EPIDEMICS OF APPARENT KIDNEY DISEASE IN CULTURED PINK SALMON, ONCORHYNCHUS GORBUSCHA. Journal of the Fisheries Research Board of Canada, Vol. 18, No. 4, pp. 559-562.

Two epidemics of a severe disease in cultured, juvenile pink salmon, O. gorbuscha, are described. The symptomatology of the disease and the morphology of the stained bacteria found in tissue lesions suggest that the fish were affected by "kidney disease". If the presumptive diagnosis is correct, this report is the first record of kidney disease occurring in pink salmon. (Auth.)

4698. Rodgers, G. K., and D. V. Anderson. 1961. A PRELIMINARY STUDY OF THE ENERGY BUDGET OF LAKE ONTARIO. Journal of the Fisheries Research Board of Canada, Vol. 18, No. 4, pp. 617-636.

Recent bathythermographic surveys carried out on the research vessel PORTE DAUPHINE have provided estimates of heat content for Lake Ontario and permitted a preliminary study of its energy losses due to evaporation, sensible heat conduction and net long wavelength back radiation, result in heating of lake water from March to August and cooling from September or October to February. The peak heat content lags the peak surface temperature by about one month. The amount of energy advected into the lake is relatively small compared with other terms in the energy budget. Thus, energy budget calculations do not depend upon the accuracy with which the water budget is known. The principal difficulty in applying present techniques for determination of an energy budget is lack of meterological data over the lake surface. (Auth.)

4699. Moss, D. D. and D. C. Scott. 1961. DISSOLVED-OXYGEN REQUIREMENTS OF THREE SPECIES OF FISH. Transactions of the American Fisheries Society, Vol. 90, No. 4, pp. 377-393.

Critical dissolved-oxygen levels and standard metabolic rates were determined for the bluegill, Lepomis macrochirus; largemouth bass, Micropterus salmoides; and the channel catfish, Ictalurus punctatus, at 25° C., 30° C., and 35° C. Two types of experiments were conducted: shock tests in which the dissolved oxygen was dropped rapidly from near saturation to a critically low point; and acclimation tests in which the dissolved oxygen was lowered gradually over a longer period of time. The minimal dissolved oxygen survived by fish in acclimation tests was lower than that survived in shock tests at any given temperature. In shock tests the minimum dissolved oxygen survived by bluegills was 0.75 p.p.m. at 25° C., 1.00 p.p.m. at 30° C., and 1.23 p.p.m. at 35° C. Slightly higher values were obtained for the largemouth bass at all three temperatures and for the channel catfish at 25° C. and 30° C. At 35° C. the channel catfish was more tolerant of low dissolved oxygen than either the bluegill or largemouth bass. In the acclimation tests the critical oxygen values obtained for the bluegills were 0.70 p.p.m. at 25° C., 0.80 p.p.m. at 30° C., and 0.90 p.p.m. at 35° C. With the exception of the channel catfish at 35° C. slightly higher values were obtained with the largemouth bass and channel catfish. Within each species there was little difference between standard metabolic rates at the three temperatures. The standard metabolic rate of the bluegill at 25° C. was lower than that of the other species at the same temperature. Bluegills and largemouth bass weighing more than 15 grams showed no change in matabolic rate with increasing size, but below this weight, metabolic rate varied inversely with weight. (Auth.)

4700. Katz, Max, and George G. Chadwick. 1961. TOXICITY OF ENDRIN TO SOME PACIFIC NORTHWEST FISHES. Transactions of the American Fisheries Society, Vol. 90, No. 4, pp. 394-397.

The toxicity of an endrin formulation to spring chinook and coho salmon, rainbow trout, bluegill, mosquitofish, guppies, and the marine threespine stickleback was determined at 20° C. Coho salmon were the most sensitive, with a 96-hour TL_m of 0.27 parts per billion endrin; sticklebacks were the most tolerant. A volume effect was demonstrated; bluegills died at lower concentrations of endrin in aquaria with the smallest number of fish. Temperature had a marked influence on toxicity of endrin to bluegills, the toxicity increasing with rise of temperature. Tolerance of endrin by marine threespine sticklebacks was about the same in waters of different salinities. Developing eggs and early larvae of the stickleback are more tolerant than fully developed fish. (Auth.)

4701. Podoliak, Henry A. 1961. RELATION BETWEEN WATER TEMPERATURE AND METABOLISM OF DIETARY PHOSPHORUS BY FINGERLING BROOK TROUT. Transactions of the American Fisheries Society, Vol. 90, No. 4, pp. 398-403.

Fingerling brook trout, Salvelinus fontinalis, were force fed a capsulated food that contained P^{32}-labeled phosphorus. A negligible direct effect of water temperature from 36° F. to 66° F. was measured on the recovery of the labeled phosphorus in the tissues of the trout through 4 days after feeding. Warmer water accelerated the rate of passage of the food through the digestive tract and the rate of digestion of the food equally. Consecutive daily feedings at water temperatures of 51° F. and 61° F. produced similar results for both water temperatures. (Auth.)

4702. Buettner, Howard J. 1961. RECOVERIES OF TAGGED, HATCHERY-REARED LAKE TROUT FROM LAKE SUPERIOR. Transactions of the American Fisheries Society, Vol. 90, No. 4, pp. 404-412.

Plantings that totaled 13,384 tagged, hatchery-reared lake trout, Salvelinus namaycush,--18, 25, 30, or 37 months old--were made at four Lake Superior localities in 1955-57 to: measure possible increases of return from rearing to greater size and age; study the effect of season of planting on the rate of return; compare returns from different types of tags; and follow the movements of hatchery-reared fish. The great advantage of spring over fall planting, demonstrated for fingerling lake trout in earlier experiments, did not hold for fish planted at ages of 18 to 37 months. The improvement of recovery rates with increase of age over the same 18- to 37-month interval appears to be too small to justify the cost of rearing to the higher ages. The recovery rates were closely similar (3.9 to 4.8 percent) for lower-jaw tags and two types of nylon-streamer tags but were much lower than the rate for Petersen tags (12.4 percent). The pins of Petersen tags render the fish highly vulnerable to entanglement in the webbing of gill nets, the principal gear in Lake Superior. Recoveries of Petersen tags also came earlier after planting than did those of other tags. The time between planting and recovery and the distance traveled by the fish were clearly but not close correlated. Mean distance between points of planting and recovery increased with time out, and average time out increased with the number of miles traveled. More than half of the recoveries of fish that had been at liberty over 2 years were made within 25 miles of the point of release. (Auth.)

4703. Berst, A. H. 1961. SELECTIVITY AND EFFICIENCY OF EXPERIMENTAL GILL NETS IN SOUTH BAY AND GEORGIAN BAY OF LAKE HURON. Transactions of the American Fisheries Society, Vol. 90, No. 4, pp. 413-418.

Gill-net selectivity curves for ciscoes, Coregonus artedii, round whitefish, Prosopium cylindraceum, chub species (mainly Coregonus hoyi, with a few representatives of C. reighardi), yellow perch, Perca flavescens, and white suckers, Catostomus commersoni, were obtained from the analysis of catch statistics of experimental nylon gill nets fished in Georgian Bay in 1958 and 1959 and in South Bay during the period of 1954 to 1959 inclusive. The method for analysis of the data is similar to that developed by McCombie and Fry (1960). The relative efficiency of nylon and cotton gill nets in catching these species has been compared on the basis of catches of each material made in South Bay. Nylon gill net was found to be 1.3 to 3.6 times as effective as cotton, depending on the species. With the exception of yellow perch, the size composition of catches made with nylon and cotton nets does not differ significantly. (Auth.)

4704. Nakamura, Eugene L., and Heeny S. H. Yuen. 1961. INCIDENCE OF THE GIANT TREMATODE, HIRUDINELLA MARINA GARCIN, IN SKIPJACK TUNA, EUTHYNNUS PELAMIS (LINNAEUS), FROM MARQUESAN AND HAWAIIAN WATERS. Transactions of the American Fisheries Society, Vol. 90, No. 4, pp. 419-423.

The greater incidence of the giant trematode, Hirudinella marina Garcin, in skipjack tuna, Euthynnus pelamis (Linnaeus), from Hawaii than in skipjack from the Marquesas led to the hypothesis that this difference in infestation was due to area. Comparisons with respect to sex, size, and time led to the conclusion that a major source of variation could be attributed to time. The available data did not allow a conclusion on whether or not a real difference exists between the two areas. (Auth.)

4705. Cooper, Edwin L. 1961. GROWTH OF WILD AND HATCHERY STRAINS OF BROOK TROUT. Transactions of the American Fisheries Society, Vol. 90, No. 4, pp. 424-438.

Various growth characteristics of the brook trout, Salvelinus fontinalis, were investigated by comparing the performance of three wild populations with five hatchery groups. Wild populations attained a total length at the end of 2 years of about 6 inches, which was less than half the size of the hatchery trout in the same period. Differences in weight between wild fish and hatchery fish for the same period were of the order of 10 times. Unfavorable temperature and lack of food were chief causes of slow growth of wild populations. Among the hatchery groups, inbreeding caused a decrease in growth. Randomly bred groups were very similar in size at all times up to 20 months of age. Growth rates of brook trout decline rapidly with increase in length or weight. Total length does not increase exponentially over long time periods, but growth in length more closely approximates a linear series with time. Different mathematical models were applied to growth data from the hatchery groups. The Walford-Ford concept was not applicable because the predicted ultimate sizes of the groups were unrealistic. The concept of Parker and Larkin appeared to describe adequately the growth curves obtained and was useful in measuring differences due to genetic factors. Weight-length curves were similar for fish of different strains grown under similar environmental conditions. Inbred groups had markedly different weight-length curves from those of randomly bred groups. A modification of

LeCren's relative condition factor, derived from the weight-length data of the hatchery groups of brook trout, is proposed. It compares the observed weight of a fish with the weight expected to promote the optimum rate of growth of the species. Examples of its use for wild and hatchery groups are given. (Auth.)

4706. Gordon, William G. 1961. FOOD OF THE AMERICAN SMELT IN SAGINAW BAY, LAKE HURON. Transactions of the American Fisheries Society, Vol. 90, No. 4, pp. 439-443.

The food of 159 young-of-the-year American smelt, Osmerus mordax and 256 I-group and older fish from Saginaw Bay was examined. Thirty-one stomachs from the first group and 35 from the second were empty. Collections were made by bottom trawl and gill nets at seven localities in depths of 2 to 36 fathoms on 11 dates from July 21 to November 1, 1956. The O-group smelt contained mostly crustaceans which were present in all stomachs that contained food. Copepods were taken more frequently than cladocerans. Other food items were Rotatoria, small unidentified eggs, and algal remains. Crustaceans, insects, and fish made up nearly all of the food in the I-group and older smelt. Mean percentage frequency of occurrence and percentage of total volume were: crustaceans, 71 and 36 percent; insects, 31 and 44 percent; fish, 8 and 20 percent. Most important crustaceans were cladocerans and Mysis, the predominant insect was Hexagenia, and all fish were young Notropis or smelt. Saginaw Bay smelt compete for food with young of all associated species and with the adults of some. They did not eat commercially exploited fish other than smelt. (Auth.)

4707. Joyner, Timothy. 1961. EXCHANGE OF ZINC WITH ENVIRONMENTAL SOLUTIONS BY THE BROWN BULLHEAD. Transactions of the American Fisheries Society, Vol. 90, No. 4, pp. 444-448.

Juvenile brown bullheads, Ictalurus nebulosus, exposed to dilute solutions of zinc chloride tagged with $zinc^{65}$ showed an initially rapid uptake of zinc for the first several hours followed by a short period of decline. After about 12 hours the accumulation of zinc proceeded at a reduced rate. The highest concentrations in the tissues were found in viscera and gills, with lower amounts in the skin, muscle, and bone. Swallowed water does not contribute appreciably to the zinc in the gastro-intestinal tract. Nearly half of the zinc accumulated after prolonged immersion in a 6-p.p.m. solution was lost during the first day after transfer of the fish to flowing, fresh water, and only slightly more after 7 days. There was no apparent damage to the fish from exposure to zinc concentrations as high as 12 p.p.m. for 14 days, nor from the effects of the radiation from the $zinc^{65}$ in the solutions. (Auth.)

4708. Brown, Edward H., Jr. 1961. MOVEMENT OF NATIVE AND HATCHERY-REARED GAME FISH IN A WARM-WATER STREAM. Transactions of the American Fisheries Society, Vol. 90, No. 4, pp. 449-456.

Movement of 248 marked and recaptured native smallmouth bass, Micropterus dolomieui, native rock bass, Ambloplites rupestris, and hatchery smallmouth bass released in a headwater tributary of the Little Miami River of Ohio during 1953 through 1957 is described. More than 91 percent of the native fishes of both species reported by anglers were taken within $\frac{1}{2}$ mile of release points. Recaptures made with electric shocker and hoop nets indicated that appreciable numbers of native fish remained within limited areas of one to several pools between successive years. Considerable numbers of stocked smallmouth bass moved away from release points. A total of 35.7 percent of fish stocked in optimum habitat in 1953 and later recovered by anglers had moved distances greater than $\frac{1}{2}$ mile. All fish stocked in submarginal habitat upstream in 1955 and later recovered by anglers moved more than $\frac{1}{2}$ mile. Except for one recapture 6 miles upstream from the release point, all returns of stocked fish were from downstream at distances ranging up to 70 miles. The proportion of fish stocked in optimum habitat in 1953 and recaptured 11 to 50 miles downstream increased significantly from 1953 to 1954, suggesting a progressive downstream dispersal. Movement of hatchery smallmouth bass was independent of size at stocking in 1953. Rapid disappearance of the 1953-stocked fish may have resulted from higher mortality, as well as from movement. (Auth.)

4709. Warner, Kendall, and Keith Havey. 1961. BODY-SCALE RELATIONSHIPS IN LANDLOCKED SALMON, SALMO SALAR. Transactions of the American Fisheries Society, Vol. 90, No. 4, pp. 457-461.

Scalation sequence and lengths at scale formation were determined for fry of three lake populations of salmon, Salmo salar Scalation was complete for Sebago Lake salmon fry at lengths of 45 to 50 millimeters, 2 months after hatching. Average length of salmon with scales just formed was 32 millimeters. Size rather than age appears to determine time of scale formation. Linear regressions for scale length on fish length were calculated for each of four salmon populations. The body-scale relationships so calculated all differed slightly. The possibility of using a generalized correction factor in direct proportion calculations of salmon lengths at previous annuli is discussed. (Auth.)

4710. Coble, Daniel W. 1961. INFLUENCE OF WATER EXCHANGE AND DISSOLVED OXYGEN IN REDDS ON SURVIVAL OF STEELHEAD TROUT EMBRYOS. Transactions of the American Fisheries Society, Vol 90, No. 4, pp. 469-474.

A field study of spawning gravel conditions affecting the survival of steelhead trout, Salmo gairdneri Richardson embryos was conducted in two small streams in the Alsea River Basin in Lincoln County, Oregon, from February to June 1959. Holes

10 inches deep, approximating natural redds, were dug in arbitrarily selected spawning locations. Plastic mesh sacks containing gravel and 100 fertilized trout eggs were placed in the upstream end of each hole. A standpipe was placed in the lower end of each excavation about 10 inches away from the eggs, and the hole was filled with gravel to the streambed level. Periodically, determinations were made of gravel permeability and of the apparent velocity and dissolved-oxygen content of the intra-gravel water. A month after calculated hatching times, the bags were removed from the streambed, and the fry contained in them were counted and preserved. The permeability of the spawning gravel fluctuated while embryos were in the gravel. During this period mean gravel permeabilities ranged from 80 to 400 meters per hour; apparent velocities from 5 to almost 110 centimeters per hour; and dissolved oxygen concentrations from 2.6 to 9.25 milligrams per liter. Embryonic survival percentages ranged from 16 to 62. There was positive correlation between the apparent velocity of ground water and embryonic survivals, and between the dissolved-oxygen levels of the gravel water and survivals. Apparent velocities and dissolved-oxygen concentrations were closely related in the intra-gravel water, and effects of these factors could not be separated. (Auth.)

4711. Pycha, Richard L. 1961. RECENT CHANGES IN THE WALLEYE FISHERY OF NORTHERN GREEN BAY AND HISTORY OF THE 1943 YEAR CLASS. Transactions of the American Fisheries Society, Vol. 90, No. 4, pp. 475-488.

Production, fishing intensity, and availability of walleyes, Stizostedion vitreum vitreum, fluctuated widely in the commercial fishery of northern Green Bay in 1929-57. The catch ranged from 16,000 pounds (8 percent of average for the 1929-53 base period) in 1942 to 1,294,000 pounds (633 percent) in 1950. The index of fishing intensity ranged from 17 (1941) to 400 (1950) and that of abundance from 47 (1929) to 222 (1955). Production and fishing intensity were consistently above average in 1947-57; abundance exceeded the average of 8 of these years. The fishery statistics and records of age and size composition of commercial landings of walleyes in the spring and fall fishing seasons of 1949-58 (scale samples were taken from a total of 1,631 fish) were the basis for a study of recent changes in the walleye fishery with particular reference to the effects of fluctuations in the strength of year classes. The 1943 year class, by a wide margin, exceeded all others in the estimated total number (1,173,000 fish) and weight (3,355,000 pounds) contributed to commercial landings. This year class was a major factor in the sharp rise in production and abundance after 1945 and the all-time record catch of 1950. In contrast, certain other year classes (1945, 1946, 1948) have contributed totals as small as 16,000 to 52,000 pounds. The abundance of the 1950, 1951, and 1952 year classes approached or exceeded that of the 1943 year class at the lesser ages (through the IV group), but these more recent classes disappeared from the fishery so rapidly that their total contributions were relatively low. The indicated increase of mortality in the middle 1950's cannot be attributed to increase in the rate of commercial exploitation. Evidence is offered that the heightened mortality rate resulted from expansion of the sport fishery. (Auth.)

4712. Jensen, Albert C., and John P. Wise. 1961. MOVEMENT OF TAGGED HALIBUT OFF NEW ENGLAND--II. Transactions of the American Fisheries Society, Vol. 90, No. 4, pp. 489-490.

Halibut of medium size or larger are capable of and do perform long migrations in the Northwest Atlantic, but whether the individual fish moved or not seems almost a matter to chance. (Auth.)

4713. Meehan, William R. 1961. USE OF A FISHWHEEL IN SALMON RESEARCH AND MANAGEMENT. Transactions of the American Fisheries Society, Vol. 90, No. 4, pp. 490-494.

The fishwheel can be a useful tool in the management of salmon runs, not necessarily as a definitive measurement of the escapement of all size classes of all species but as an index of the magnitude of the escapement. It is quite possible that in many rivers the bias of the wheel will be constant from year to year and hence can be taken into consideration when measuring the escapement. In some cases the combined use of a fishwheel and other gear such as various-sized gill nets might be a practical answer to the accurate measurement of escapement. The individual physical conditions encountered in a particular river system will undoubtedly play an important role in determining the best methods for operating a fishwheel and other companion sampling gear in that system. (Auth.)

4714. Springer, Victor G., and Andres J. McErlean. 1961. TAGGING OF GREAT BARRACUDA, SPHYRAENA BARRACUDA (WALBAUM). Transactions of the American Fisheries Society, Vol. 90, No. 4, pp. 497-500.

Twenty-two specimens ranging in size from 404-1,083 millimeters (average, 586 millimeters) showed insignificant net movement. They were at large from 4 to 239 days (average, 58 days). Eight specimens ranging in size from 592-1,107 millimeters (average, 831 millimeters) showed net movement of from 4-120 miles. They were at large from 6-430 days (average, 87 days). From these meager data it would appear that only fairly large barracuda move any long distance. (Auth.)

4715. McErlean, Andrew J., and Ronald C. Phillips. 1961. A TECHNIQUE FOR DIRECT PHOTOGRAPHY OF TRANSLUCENT OBJECTS. Transactions of the American Fisheries Society, Vol. 90, No. 4, pp. 500-501.

The method described was developed to demonstrate annuli in otoliths of various serranid fishes in which the age or number of rings is large. (Auth.)

4716. Bosley, Clifford E. 1960. PRE-IMPOUNDMENT OF THE FLAMING GORGE RESERVOIR. Wyoming Game and Fish Commission, Fisheries Technical Report Number 9, 81 pp.

The Flaming Gorge Reservoir is scheduled for completion in 1962. Impounded waters will back up the Green River to within four miles of the town of Green River, Wyoming. An estimated 300,000 people will utilize the reservoir annually for recreational purposes.

Gill net sets, electrofishing, and toxicant applications indicate that the game fish populations, within the confines of the reservoir, are negligible. Trash fish populations are very high with suckers, bonytails, squawfish, and carp representing the majority of fishes present. The removal of trash fish populations is feasible under certain conditions.

Reservoir contours and physical data indicate that two types of habitat will exist. The main body of the reservoir and canyon area will contain habitat suitable for salmonid species, and the numerous arms and bay areas will furnish habitat for warm water species.

Initial game fish populations will be stocked with the thought of maximum reproduction potential in mind. Potential spawning grounds exist for salmonid species in the Green River proper above the reservoir and in the tributaries of Henry's Fork and Carter Creek.

Experimental eyed and green kokanee egg plants in the Green River proper and Henry's Fork indicate that prolonged low water temperatures existing during the incubation period of this species will virtually eliminate any natural reproduction from late running fish.

Chemical, physical and biological studies indicate that the lower section of the Green River above the town of Green River is capable of producing a better game fishery than it is at the present time.

The advent of the Seedskadee project, approximately sixty river miles upstream from the backwaters of the Flaming Gorge Reservoir, will change the chemical and physical characteristics of the Green River between the two projects. Of these changes the alteration of stream flows, increased water temperatures, and increased turbidities may have a detrimental effect upon the natural spawning potential of the Green River proper. (Auth.)

4717. Kojima, Shumpei. 1961. MIGRATORY HABITUDE OF THE YOUNG YELLOWTAIL BASED ON TAGGING EXPERIMENTS. Bulletin of the Japanese Society of Scientific Fisheries, Vol. 27, No. 4, pp. 291-295.

As far as adult yellowtail, Seriola quinqueradiata, are concerned, tagging experiments have been successfully conducted to prove a distinct migration along the coastal waters off Japan. However, the amount of data previously obtained from tagging young yellowtail has been insufficient to define their migration. Therefore, the author liberated 160 tagged young fish along the Japan Sea coast of Shimane Prefecture. At the time of liberation in May 1958 and June 1959, they were about two years old with fork lengths ranging from 36 to 45 cm. Analytical studies of the fish recovered by October 1, 1960 revealed the following information.

The number of the recovered individuals was 34, constituting 22 percent of the total released. Among the recovered fish those which stayed in the sea for three to nine months after liberation represented 53 percent, and those staying out over nine months were 32 percent.

Assuming that an area within a radius 30 miles from a releasing point belonged to a body of a homogeneous water, most of the recoveries were made in that area. The fact suggests that the young yellowtail have a rather limited range.

They were recaptured throughout the year either in a bay, shallow water or on a reef within five miles off the shore.

Although the migratory habits seem dependent upon the topography of a liberation area, it is interesting to note that those released from the Oki Islands appear to have migrated around the islands once or twice a year in conformity with the coastal currents in the areas.

The recovered fish had a body weight ranging from 0.8 to 2.0 kg. and a body length up to 50 cm. On the basis of a previous study none of them could be regarded as older than three years. (Auth.)

4718. Hiyama, Yoshio, Yukio Nose, Makoto Shimizu and Junko Matsubara. 1961. ON THE PREDATION OF RAINBOW TROUT FRY TRACED BY Co^{60} BODY CAVITY TAG Bulletin of the Japanese Society of Scientific Fisheries, Vol. 27, No. 4, pp. 296-301.

At about noon of May 1st, 1960, 191 rainbow trout fry, of which 39 had a Co^{60} pin radiation source (about 100 μc) inserted in the abdominal cavity, were liberated. Since that afternoon, the vicinity around the stream was monitored by Crystal Scintillation Survey Meter (1 1/2" NaI Crystal) and by G-M Survey Meter at least once a day, and the locations where the radiation sources were detected were recorded on the map.

The recovery of Co^{60} marked fry and Co^{60} pins outside the liberated fry was done from May 9-11 and July 26-29. Thirty-six pieces of Co^{60} pins were recovered: (1) 21 individuals of living fry carrying the Co^{60} pins inside their body; (2) 10 pieces of the pins found on the bottom sand of the stream; (3) 5 pieces of the pins found in the holes under rocks.

The 10 pieces of Co^{60} pins found on the bottom sand, was probably caused by predation and excretion of adult trouts. If so, the adult trout had taken about 1/4 of the liberated fry within 8 days.

The 5 pieces of the pins found in the holes under huge rocks was probably the result of predation and excretion of Japanese water shrew which nested in the experimental area. The quantity of predation during 8 days by this mammal was estimated as about 1/8 of total fry liberated.

However, the predation by a wild bird, Cinclus pallasii, the most powerful predator in the last

year's experiment, was not recognized, though a couple of these birds with two young were often found flying in the experimental area.

One of the reasons why the bird did not prey on the fry was thought to be that the size of fry liberated this year (average 8 gr.) was much larger than that of last year (average 1.2 gr. for the small-sized group and 2.7 gr. for the large-sized group). Moreover, the distance from the point of liberation to the nest of this bird this year was farther than that of last year. (Auth.)

4719. Nakagome, Jun. 1961. SEASONAL VARIATION OF SWIMMING LAYER OF YELLOWFIN TUNA BY AREA OF DIFFERENT CURRENTS IN MID-WESTERN AND SOUTHWESTERN PARTS OF THE PACIFIC OCEAN. Bulletin of the Japanese Society of Scientific Fisheries, Vol. 27, No. 4, pp. 302-306.

The author studied the seasonal variation of the swimming layer of yellowfin tuna by area of different currents in the mid and southwestern parts of the Pacific Ocean. The results are as follows:

The swimming layer became shallowest (about 110m) in June and deepest (about 145m) in December in areas of the North Equatorial current and the Equatorial Counter current tended to rise in the spring and sink in the fall.

The swimming layer became shallowest (about 110m) in May and deepest (about 145m) in November in the South Equatorial current area north of the convergency line (10° S). It tended to rise in winter toward spring and sink in summer toward autumn.

The swimming layer became shallowest in March (about 105m) and October (about 90m) and deepest in January (about 130m) and June or July (about 135m) of a year in the South Equatorial current area south of the convergency line. It tended to rise and fall periodically twice a year. (Auth.)

4720. Suzuki, Ryo. 1961. EXTERNAL CHARACTERS OF ARTIFICIAL INTERGENERIC HYBRIDS AMONG JAPANESE BITTERLINGS (CYPRINID FISH). Bulletin of the Japanese Society of Scientific Fisheries, Vol. 27, No. 5, pp. 418-424.

It is well known that intergeneric hybrids can be reared artificially to adult size among teleost fishes. These hybrids are intermediate between parental species in most taxonomic characters. Natural intergeneric hybrids have also been found by some investigators. Interspecific hybrids have been more easily produced into adult size than in the cases of the above mentioned hybrids. Interfamilial hybrids, however, cannot be reared to adult size, because all hybrids die at early stages of development due to deformities. These findings reveal that the level of hybrid development correlates with that of the taxonomic relationship of parent species.

The author attempts to hybridize by artificially mixing gamates of five species of Japanese bitterlings belonging to two genera. Five kinds of intergeneric hybrids can be reared to adult size, about one or two years old, though hybrid females are inviable in most cases and all the males are sterile. External characters of these hybrids will be explained in the present paper comparing with those of parental species. Exact descriptions as to the viability and the sterility of the hybrids will be published in a separate paper. (Auth.)

4721. Yamada, Tetuo. 1961. ON THE VERTEBRAL LENGTH CURVE OF TELEOSTS. Bulletin of the Japanese Society of Scientific Fisheries, Vol. 27, No. 6, pp. 510-515.

The author has examined the vertebral length curves (VLC) of one hundred species of teleosts, mainly perciform fishes, and got the following results:

The fishes examined have their own type of VLC respectively, so VLC may be useful for the systematic study of fishes.

VLC of fishes vary gradually according to the progress of body growth, but in some fishes such as mackerels, dorados, etc., they are unvarying.

VLC of fishes may be divided into three main groups, the premodal, the postmodal and the bimodal which have close systematic relations to each other.

VLC of bottom fishes are generally steeper than those of surface fishes. (Auth.)

4722. Onodera, Kosi. 1961. ON THE ESTIMATION OF CATCH AND FISHING EFFORT IN RIVER BY A NEW METHOD OF CREEL CENSUS. Bulletin of the Japanese Society of Scientific Fisheries, Vol. 27, No. 6, pp. 521-529.

Procedure and method for the estimation of total catch, total fishing effort, and catch per unit of effort are presented.

The survey required two systems: A creel census and a check survey.

The former determined total catch effort together with representative time for the application of corrective coefficients, while the latter determined corrective coefficients.

Three kinds of corrective coefficient were needed: for total catch, for total effort, and for catch per unit of effort. (Auth.)

4723. Onodera, Kosi, and Tatsuji Ueno. 1961. ON THE SURVIVAL OF TROUT FINGERLINGS STOCKED IN A MOUNTAIN BROOK. II. SURVIVAL RATE MEASURED AND SCOURING EFFECT OF FLOOD AS A CAUSE OF MORTALITY. Bulletin of the Japanese Society of Scientific Fisheries, Vol. 27, No. 6, pp. 530-557.

Floods caused a large mortality of 50.4 to 62% rainbow trout fingerlings, and 67.9 to 83.7% brook trout fingerlings at each flood.

Floods had scouring effects and decreased rainbow trout fingerlings 75.3 to 95.5% and brook trout 99.0 to 100%, though some of them were expected to remain in some downstream area. (Auth.)

4724. Nicholls, A. G. 1961. THE TASMANIAN

TROUT FISHERY. IV. THE RIVERS OF THE SOUTH AND SOUTHEAST. Australian Journal of Marine and Freshwater Research, Vol. 12, No. 1, pp. 17-53.

Two main river systems are included in this region, the Derwent and the Huon. Data derived from anglers' returns are analyzed for each system separately but those from the Hyon are insufficient for a thorough study. There is some doubt as to the representativeness of returns from either system. No significant changes have been found in the fishery over a period of 12 seasons either in the rate of daily catch per angler or in the length of fish taken. A study of the fish taken in an upstream trap at spawning time yields an annual mortality rate of about 60% for the Derwent River System and recaptures of tagged fish show a similar rate. Population estimates based on recaptures of tagged fish and on the spawning potential within the system indicate a total population of between one-half and one million, of which about 20% is of takable size. The contribution made by the release of hatchery-reared fish is shown to be insignificant. Evidence is produced which leads to the conclusion that there may be two distinct races of trout in Tasmania, the result of separate introductions of river and sea trout, distinguished by inherent meristic differences as well as by differences in growth rate and habits. (Auth.)

4725. Takagi, Kenji. 1961. THE SEASONAL CHANGE OF GONAD WEIGHT OF SOCKEYE AND CHUM SALMON IN THE NORTH PACIFIC OCEAN, ESPECIALLY WITH REFERENCE TO MATURE AND IMMATURE FISH. Bulletin of the Hokkaido Regional Fisheries Research Laboratory, No. 23, pp. 17-34.

A method to distinguish between immature and maturing sockeye and chum salmon was studied using data of gonad weight, body weight, body length and age taken by Japanese mother-ships in 1957-59.

Commercial sized immature salmon may be distinguished, depending on a gap in frequency distribution of gonad weight, though the gap moves as the fishing season advances. Commercial catch taken early in the season may be almost entirely composed of maturing salmon due to the selectivity by the mesh size.

Comparing the rate of increase in gonad weight with that in body weight, the former increases rapidly in the maturing stage, while the latter increases slowly.

Differences of body weight and of body length were found between immature and maturing fish, but the both would not be distinguished by body weight nor by body length because of too much duplication of the frequency distribution.

Early in the fishing season two heterogeneous groups of maturing sockeye were recognized from the data of ovary weight. Of these, the group with heavy ovary was traced as migrating northward and disappearing from the commerical catch after June. (Auth.)

4726. Booker, P. G. 1961. NEW SEA TEMPERATURE MEASURING DEVICES. Journal Du Conseil, Vol. XXVI, No. 2, pp. 133-147.

The paper describes new types of (i) a temperature-depth recorder and (ii) a thermistor thermometer.

The temperature-depth recorder draws an instantaneous profile on a graphed paper roll showing the relation between temperature and depth. The equipment comprises an underwater unit connected to a control unit and recorder through a 550 m length of cable. The thermistor thermometer is capable of reading temperature at some remote point by means of a thermistor temperature sensing unit joined through a length of cable to a control unit which has a micro-ammeter calibrated directly in °C.

Both devices are accurate to $\pm 1\%$ full-scale deflection. (Auth.)

4727. Vatova, Aristocle. 1961. PRIMARY PRODUCTION IN THE HIGH VENICE LAGOON. Journal Du Conseil, Vol. XXVI, No. 2, pp. 148-155.

The primary production of organic matter in the High Venice Lagoon or Lido Basin was determined through the ^{14}C technique. The extent of the photosynthetic zone was calculated by multiplying the transparency, measured with Secchi discs, by 3.3.

In the spring and summer of 1959 the production at low tide was about three times greater than the production at high tide, values being 88 and 29 g C/m^2 respectively, notwithstanding the smaller extent of the photosynthetic zone (4.6 m at low tide and 6.3 m at high tide). The difference is due to the presence of nutrient salts, particularly phosphates and nitrates, which originate from the decay of the drainage liquids coming from Venice and its environments.

In the autumn and winter of 1959, however, the production at low tide was almost the same as at high tide, values being 14 and 13 g C/m^2 respectively, owing to the lower temperature of the water at low tide.

In 1959 the average yearly production in the High Venice Lagoon, which is a eutrophic lagoon, was therefore higher than in most marine areas, its values being 42 g C/m^2 at high tide and 105 g C/m^2 at low tide (total yearly production 147 g C/m^2). The total net production is estimated at 1.2×10^4 tons carbon per year. (Auth.)

4728. Bishai, H. M. 1961. THE EFFECT OF SALINITY ON THE SURVIVAL AND DISTRIBUTION OF LARVAL AND YOUNG FISH. Journal Du Conseil, Vol. XXVI, No. 2, pp. 166-179.

Newly hatched herring larvae can live at salinities as low as 2.5 0/00. They live better and longer in salinities from 10-15 0/00 than in higher or lower salinities.

Lump-sucker larvae can live for at least 14 days at 9 0/00 salinity. Salinities below 5 0/00 prove fatal within less than 24 hours. Acclimation

to low salinities, although causing an increase in the resistance time, does not seem to affect the lower lethal limit of salinity (i.e. 5 0/00).

Young plaice (38-50 mm long) can live at low salinities of 5 0/00 for at least ten days. Lower salinities can be tolerated for a few days. Even fresh water has no ill effects on the fish for about 20 hours.

Salmon, sea trout, and brown trout alevins can live for at least 10 weeks at salinities up to 9.20 0/00 (25% sea water). At a salinity of 9.84 0/00 (30% sea water) salmon is more tolerant than brown trout and sea trout. Brown trout is more resistant as compared with sea trout. At 40% sea water salmon alevins show more resistance and can live for 18 days while sea trout and brown trout can live for 9 and 11 days respectively. At 50% sea water the alevins of the three species live for about one week.

The resistance of salmon, sea trout, and brown trout to salinity changes seems not to change while the yolk-sac is not completely absorbed. (Auth.)

4729. Gulland, J. A. 1961. THE ESTIMATION OF THE EFFECT ON CATCHES OF CHANGES IN GEAR SELECTIVITY. Journal Du Conseil, Vol. XXVI, No. 2, pp. 204-214.

A method of estimating the effect on catches, both immediate and long-term, of changes in the selectivity of the gear, is described.

This depends essentially on knowing the size-composition of the present catches. From this, and a knowledge of the selection curves of the new and old gears, the immediate effect in terms of the numbers of fish retained (N_K), and released (N_R) can be calculated. Of the N_R fish, some ($=N_R e^{-Mt'}$) will live through the average time interval, t', needed to grow to the size retained by the new gear; of these a proportion, E, will ultimately be caught. Thus the immediate catch will be increased in the ratio $N_K : N_K + EN_R e^{-Mt'}$.

The method can be easily extended to cover fisheries in which more than one gear is operating, not all of which change their selectivity.

If fish are discarded at sea, the method gives too pessimistic an estimate of increases in size at first capture. (Auth.)

4730. Strasburg, Donald W. 1961. DIVING BEHAVIOR OF HAWAIIAN SKIPJACK TUNA. Journal Du Conseil, Vol. XXVI, No. 2, pp. 223-229.

Observations from an underwater chamber showed that schools of skipjack commonly dive during fishing, leaving the surface for a minute or more on many occasions. Stomach analyses showed that the presence of two prey fish, Synodus variegatus and Holocentrus lacteoguttatus, was significantly related to diving frequency. It was hypothesized that these two species were more attractive than the live bait used by the fishermen, and that the skipjack dived in pursuit of them. A study of the characteristics of attractive natural food may lead to the development of better bait and lures for catching skipjack. (Auth.)

4731. Erickson, Jack. 1961. MUSKELLUNGE STOCKING EVALUATION IN DEER CREEK RESERVOIR, STARK COUNTY, OHIO. Ohio Department of Natural Resources Division of Wildlife, Publication W-314, 6 pp.

Deer Creek Reservoir was stocked with muskellunge fry in the first year of flooding. A large crop of carp and gizzard shad occurred in this same year.

From a total of 19,030 fry stocked in the reservoir, 117 muskellunge from 7 to 42 inches long have been recorded.

Length frequency distribution from test-net and angler-caught fish and age-growth data indicate that the crop of muskellunge resulted from the initial stocking of 1955, with only an occasional survival from later plantings. The 117 recorded fish represents a 5.8 percent survival of the original plant of fry.

Five years after the initial planting of 2,000 muskellunge fry, 21 five-year old fish or 1.05 percent of the plant were taken in test nets. This indicates that liberalized fishing did not result in complete removal of the population, but that a large enough population survived to reproduce.

This data indicates that the first year of stocking, during the year the lake was filled, produced the only practical results from the total of 19,030 fry planted in the lake. This may indicate that increasing the size of the stocked fish after the first year would produce better results. The success in the first year may also have been correlated with the large crop of shad and carp fry or other unknown factors. (Auth.)

4732. Allen, K. Radway. 1961. RELATIONS BETWEEN SALMONIDAE AND THE NATIVE FRESHWATER FAUNA IN NEW ZEALAND. Proceedings of the N. Z. Ecological Society, No. 8, pp. 66-70.

The introduction of Salmonidae has probably not led to any great change in the fauna of New Zealand freshwaters, particularly where the bottom fauna is concerned. It is however possible that a few species have been adversely affected; these are likely to be forms which combine habits and appearance making them attractive to trout, with a low biological potential giving them little capacity to withstand increased predation. This conclusion might have been unexpected if New Zealand freshwaters had been originally without carnivorous fish, but in most of our waters the bottom fauna was in fact already subject to considerable predation from a fish population including, to varying extents in different localities, the smaller eels, the larger bullies and galaxiids, and the grayling, Prototroctes oxyrhynchus. The virtually complete disappearance of grayling between 1870 and 1925, from previous great abundance, is, incidentally, by far the most striking biological change which is known to have

occurred in New Zealand waters. Since it has happened in some places where trout are still scarce or absent, and in others had begun before trout arrived, it does not seem that, whatever its cause was, it can be laid at the door of the salmonids.

The reverse relationship, predation on Salmonidae by native animals, may be more briefly considered. The two principal groups of predators are shags, particularly the black shag, Phalacrocorax carbo, and eels, especially the long-finned eel, Anguilla dieffenbachi. Although both species are undoubtedly predatory on trout to some extent, the existing trout populations were established in the face of this predation, and it seems unlikely that the native predators will seriously menace their continued survival. (Auth.)

4733. Marvin, Kenneth T., Larence M. Lansford, and Ray S. Wheeler. 1961. EFFECTS OF COPPER ORE ON THE ECOLOGY OF A LAGOON. U. S. Fish and Wildlife Service, Fishery Bulletin 184, Vol. 61, 8 pp.

A large-scale experiment was conducted in a lagoon, off the Galveston Ship Channel in the Gulf of Mexico, to determine the feasibility of using copper ore as a control for destructive plankton blooms. A chemical and biological study was made of the lagoon for a period of 9 months previous to the addition of 60 tons of copper ore. Comparison with a similar study made after the addition of the ore revealed that the ore did not have the desired qualities of control; therefore its use for control was not recommended. (Auth.)

4734. Sindermann, Carl J., and Donald F. Mairs. 1961. BLOOD PROPERTIES OF PRESPAWNING AND POSTSPAWNING ANADROMOUS ALEWIVES, ALOSA PSEUDOHARENGUS. U. S. Fish and Wildlife Service, Fishery Bulletin 183, Vol. 61, 7 pp.

As part of a general investigation of the potential value of fish blood characteristics to the solution of population and migration problems, a study of modifications induced by environmental and physiological variables has been made. Six blood properties of prespawning and postspawning anadromous alewives, Alosa pseudoharengus, were compared. Changes that could be attributed to fresh-water migration and reproduction were found in only two of these properties; viz., significant reductions in average serum proteins and chlorides of postspawners. No important differences in average sedimentation rate, erythrocyte fragility, hemoglobin content, or serum electrophoretic pattern were found when fish entering fresh water in May were compared with seaward migrants 1 to 2 months later. Serum electrophoretic patterns were generally similar to those of other clupeoids, with fractions having mobilities comparable with human albumin and human alpha- and beta-globulins, but with little representation in the area of gamma-globulins. Great individual variations in hemoglobin content, total serum proteins, serum chloride, and sedimentation rate were found in alewives both before and after spawning. (Auth.)

4735. Dunham, Charles L., et al. 1961. OFF-SITE ECOLOGICAL RESEARCH OF THE DIVISION OF BIOLOGY AND MEDICINE--TERRESTRIAL AND FRESHWATER. U. S. Atomic Energy Commission, TID-13358.

This booklet on terrestrial and freshwater ecology is one in a series of such publications in preparation to describe research programs supported by the Division of Biology and Medicine, U. S. Atomic Energy Commission. Its purpose is to acquaint interested scientists with the biomedical program of the Commission, its objectives and justification. Further, experimental procedures are described with the hope of stimulating and improving research in radioecology. (Auth.)

4736. Walker, Boyd W., et al. 1961. THE ECOLOGY OF THE SALTON SEA, CALIFORNIA, IN RELATION TO THE SPORTFISHERY. State of California Department of Fish and Game, Fish Bulletin No. 113, 204 pp.

The history, physical and chemical characteristics, and biota of the Salton Sea are discussed.

Management recommendations are based solely on biological grounds, and only those actions which would directly benefit the fishery are encouraged.

The most important food chain to the sportfishery is: phytoplankton $\longrightarrow$ zooplankton $\longrightarrow$ detritus $\longrightarrow$ detritus eating worm (Neanthes) $\longrightarrow$ worm-eating fish (bairdiella and sargo) $\longrightarrow$ fish-eating fish (corvina).

The weakest link in this chain is at the level represented by Neanthes. This single species is the only organism in the Sea converting detritus into food for bairdiella and sargo. This stage in the chain is probably strong as regards to efficiency, however.

Of secondary importance is the food chain: phytoplankton $\longrightarrow$ zooplankton $\longrightarrow$ threadfin shad $\longrightarrow$ corvina.

We think it best to limit the fish fauna to a few forms. In this way production of the most desirable species should be highest.

We recommend a conservative attitude toward introducing new forms. New fishes should be planted only if the present fishery proves inadequate.

Zooplankters which would strengthen the food chain during summer would be desirable.

Mysids and amphipods would strengthen the food chain at the Neanthes level, and should be introduced.

4737. Alm, Gunnar. 1961. DIE ERGEBNISSE DER FISCHAUSSÄTZE IN DEN KÄLARNE-SEEN. Institute of Freshwater Research, Fishery Board of Sweden, Report No. 42, pp. 5-83.

The program for the activities of the Kälarne Fishery Research Station as laid up in the beginning of the 1930's contained, amongst others, experiments aimed at utilizing the numerous small lakes and tarns in the neighbourhood, many of which were

empty of fish, for sport-fishing and for local consumption. Lakes of this type are very common in large parts of the forest areas in northern Sweden. Although often of rather insignificant size, they can offer considerable advantages to the people living near them, provided the supply of fish is good.

All the lakes are of oligotrophic type, but their humic standard varies within wide limits. This finds its expression in the transparency and the colour of the lakes which accordingly have been classified into 4 groups. Group I contains lakes with transp. <2.0, group II transp. 2.1--3.0, group III transp. 3.1--5.0, and group IV transp. >5.0. Average values for the transparency, as determined with the white disk, and for pH, according to Czensny's pH-scale, are given. For a number of lakes also alkalinity (cm^3n/10 HCl in 100 cm^3) and conductivity ($K_{20} \cdot 10^6$) are recorded. Water samples for the determination of temperature and content of O_2 have been taken in all lakes in summer as well as generally also in winter, occasionally also in spring.

Many small lakes empty of fish can be suitably planted with different forms of salmonids and coregonids, sometimes also with char and brook-trout. Often the value of the recaptured fish already more than repays the expense of the planting. Yet much greater revenues can be realized, if these small lakes are made accessible to sport-fishing. One has, however, to be prepared for the necessity of renewed plantings, either on account of the fact that propagation fails to take place or that the fish die by suffocation, when during long winters with plenty of snow the O_2-conditions become too unfavourable. Also in small lakes with only perch the planting of the above-mentioned species may turn out well, but ought to be effected there with larger fingerlings reared in ponds or with young of trout and brooktrout transferred from other lakes. If, however, perch or other less valuable fish are very common and small-sized, it is safer to use the now common rotenone methods and entirely eliminate the original population. (Auth.)

4738. Axelson, Jan. 1961. ZOOPLANKTON AND IMPOUNDMENT OF TWO LAKES IN NORTHERN SWEDEN (RANSAREN AND KULTSJÖN). Institute of Freshwater Research, Fishery Board of Sweden, Report No. 42, pp. 84-168.

The zooplankton of two lakes in Northern Sweden, Ransaren and Kultsjön, has been investigated. Beside the studies of general zooplankton problems special attention has been given to the regulation of Ransaren and the changes in the zooplankton values from Kultsjön have mainly been used as a reference material in order to exclude, as far as possible, the changes that are due to the natural variation.

In all, 33 species have been observed, many of which are quite rare. The following species are dominating in the open water: Cyclops scutifer, Diaptomus laticeps, and D. graciloides among the copepods; Daphnia galeata among the cladocerans and Polyarthra vulgaris, Kellicottia longispina, Conochilus unicornis, and Keratella cochlearis among the rotifers.

The investigation of the horizontal and vertical distribution of the species has shown that the water movements are of vital importance. A surface transport of water may produce zones of unequal productivity and concentrate the zooplankton in one end of the lake. The swinging of the thermocline in the case of internal seiches sometimes changes the vertical position of the species to such an extent that the migratory movements of the animals are overruled.

In the littoral zone zooplankton swarms have been observed which to some extent may have been caused by the regulation.

Due to the regulation of Ransaren and environmental conditions have become more favourable and in 1957 and particularly in 1958, when the impoundment almost reached the upper limit for the regulation, a marked increase of the number of individuals took place. This increase is not only caused by improved environmental conditions but can also be ascribed to reduced losses in the summers when the lake was almost completely closed.

The discharge from the lake seems to play a considerable role in regulating the abundance of the epilimnic species. Particularly during the growth season the draw-off of water impoverishes the plankton which may also result in deteriorated food conditions for the fish.

In the Kultsjön the standing crop of zooplankton has remained unchanged through all the years. Thus no effect of the regulation of the lake in the period 1958-1960 has been observed. (Auth.)

4739. Grimås, Ulf. 1961. THE BOTTOM FAUNA OF NATURAL AND IMPOUNDED LAKES IN NORTHERN SWEDEN (ANKARVATTNET AND BLÅSJÖN). Institute of Freshwater Research, Fishery Board of Sweden, Report No. 42, pp. 183-237.

Bottom samples covering an area of 10.8 sq. m. of soft bottom and 7.9 sq. m. of block bottom and 369 insect hatching samples have been analyzed from the natural Lake Ankarvattnet and the impounded Lake Blåsjön.

The water level fluctuations have caused a quantitative reduction of the bottom fauna, in the zone of fluctuations estimated to 70 percent, in the remaining areas to 25 percent. Maximal abundance of the bottom fauna in the impounded lake is found immediately below the draw down limit.

Great quantitative changes have occurred in the balance between the different groups of bottom animals, involving an increased share of Chironomidae and a decrease of benthonic Crustacea, the Oligochaeta being indifferent. Animals being dependent on an intact littoral zone are heavily reduced.

Some groups of animals, e.g. Gastropoda, that have been almost eliminated in the depth zone normally comprising optimal habitat conditions

have increased in abundance within new areas below the draw down limit.

The reduction of filtrating organisms below the draw down limit even in the profundal regions is suggested to depend on the disturbance of the stratifications in bottom surface layers, caused by minerogenic material eroding from the regulated area.

As a result of the general reduction of chironomid species, the periods of emergence are limited to a few heavy concentrations especially within the regulated area. The emergence maximum normally occurring in natural lakes during spring is almost eliminated in the whole littoral.

The increased abundance of Cladocera that follows the first years of damming up has ceased 10 years after the start of regulation and, moreover, as an effect of the continuous erosion, decreased in abundance.

There is a general tendency towards higher abundance of bottom animals in the vicinity of inflows, which is supposed to depend on a combined effect of outdrifted animals and a richer supply of nutrients in these areas.

A special study was carried out on the temperature conditions in bottoms affected by drainage and freezing during the draw down period. Of the animals from the frozen-in bottoms 80 percent of the individuals were alive. (Auth.)

4740. Nilsson, Nils-Arvid. 1961. THE EFFECT OF WATER-LEVEL FLUCTUATIONS ON THE FEEDING HABITS OF TROUT AND CHAR IN THE LAKES BLÅSJÖN AND JORMSJÖN, NORTH SWEDEN. Institute of Freshwater Research, Fishery Board of Sweden, Report No. 42, pp. 238-261.

The changes in the abundance and composition of the prey fauna occurring as results of artificial water-level fluctuations act essentially upon the feeding habits of the fish. Some important prey species (e.g. Gammarus) disappear or get rare, others (e.g. terrestrial insects) increase in importance.

The decrease in growth rate occurring some years after the start of water-level regulation that has been established from many other lakes could be explained only upon the basis of this change from a substantial, constantly available food to a less substantial, more occasional food, but also the "over-production" of nourishment occurring during the first years of damming-up might contribute to a decreased growth rate because of rich year classes and a resulting stunting.

The present material confirms at all events that the process that has been started will develop slowly: there is no reason to believe that a new equilibrium in the organic life should have been established even ten or twenty years after the start of regulation.

It could be expected that trout should be the most severely suffering species as it is bound to the littoral zone of the lake during the important part of the growth period, without being able to leave it though the significant prey species have disappeared or have been essentially thinned out. Char, on the other hand, feeds essentially on plankton, though it lives on more substantial food during the growth period in spring and early summer. There are thus reasons to believe that the changes in growth rate caused by changed feeding habits should be less drastic in the case of char than in the case of trout which on account of its ecological "rigidity" is forced to search after the small remnants of littoral food. To this difference may be added also the difference in behavior between the two species involving a tendency towards territorial behavior in trout and a more roaming behavior in char that permits feeding, where opportunity avails itself. The mouths of the inlet rivers and brooks and impounded areas like "Libotten" in Jormsjon are very important as food refuges for the fish after the artificial water-level fluctuations have started. (Auth.)

4741. Goryunova, S. V., and L. K. Osnitskaya. 1960. THE BIOLOGICAL INSTITUTE OF THE HUNGARIAN ACADEMY OF SCIENCES. (BIOLOGICHESKII INSTITUT VENGERSKOI AKADEMII NAUK.) Izvest. Akad. Nauk Ser. Biol. 6. 942-944, 1960; Referat. Zhur., Biol., 1961, No. 7A18; Biological Abstracts, Vol. 36, No. 19, Abst. No. 62408. 1961.

The Institute, located on the shore of Balaton Lake on the Tikhan Peninsula, 125 km from Budapest, has 3 divisions: (1) hydrobiology; (2) experimental botany; (3) experimental zoology. The first division studies the need for oxygen in various species of fish under various environmental/temperatures, conversion of lipoid substances in a trophological series, vertical and horizontal distribution of phyto- and zooplankton in the depth of Lake Balaton, the ecology of water plants (mainly diatoms). This division conducts hydrological research in Lake Balaton, studying the decomposition of organic substances in the bottom deposits, and the connection between the central nervous system and hormonal formations in invertebrates. The second division has been studying algae, in particular the removal of algae from the reservoir and separation of the Protococcaceae. The principal subject of the third division is the study of the comparative physiology of protozoa. (Auth.)

4742. Pavlovskii, E. N., and G. V. Nikol'skii. 1959. THE PRACTICAL EXPERIENCE OF THE SCIENTIFIC COUNCILS IN OUR MOST IMPORTANT PROBLEMS. (ON THE ACTIVITIES OF THE ICHTHYOLOGICAL COMMISSION). (IZ OPYTA RABOTY NAUCHNYKH SOVETOV PO VAZHNEISHIM PROBLEMAM (O DEYATEL' NOSTI IKHTIOLOGICHESKOI KOMISSII)). Vestnik Akad Nauk SSSR 29(7): 39-42. 1959; Referat. Zhur., Biol., 1961, No. 5D417; Biological Abstracts, Vol. 36, No. 19, Abst. No. 62414. 1961.

The Ichthyological Commission of the Academy of Science of the USSR is a council on the problem

of "The biological bases for the rational utilization and replenishment of the fish, other animals and plant resources of the seas and inland reservoirs". The Commission makes a scientific report on this problem which has served to orient future research, and has held regular conferences on the raising of fish in ponds and on problems of acclimatization (1952), on the salmon industry of the Far East and the behavior and breeding of fish (1953), on the methods of studying the nutritional basis and nutrition of fish and on fish raising (1954), on the physiology of fish (1956), on the effect of waste waters on aquatic organisms and on diseases of fish (1957), on the biological principles of marine fishing and on the utilization of water reservoirs in the fish industry (1958). The Commission coordinates the work of more than 100 institutes with participation of 1500 scientists. (Auth.)

4743. Penaz, Milan, and Jiri Libosvarsky. 1961. UTILIZATION OF THE ZEISS READING APPARATUS IN EXAMINING FISH SCALES. (POUSITI ZEISSOVA ČTECÍHO PŘISTROJE PRO VÝZKUM RYBÍCH ŠUPIN.) Zool. Listy. 24(2): 183-184. 1961; Biological Abstracts, Vol. 36, No. 19, Abst. No. 62563. 1961.

The reading apparatus Dokumator, made by Veb C. Zeiss, Jena, has been successfully used for scale analyses. This apparatus possesses a light source of sufficient intensity and two sets of exchangeable objectives with condensers, allowing for 10.5 and 17 x magnification. The latter is quite sufficient for examining scales of a majority of fish species. (Auth.)

4744. Rezvoi, P. D., and N. S. Yalynskaya. 1960. METHOD OF DETERMINING THE BIOMASS OF PLANKTON AND BENTHOS. (K METODIKE OPREDELENIYA BIOMASSY PLANKTONA I BENTOSA.) Zool. Zhur. 39(8): 1250-1252. 1960; Referat. Zhur., Biol., 1961, No. 5D712; Biological Abstracts, Vol. 36, No. 19, Abst. No. 62564. 1961.

Objects to be weighed were placed on the pans of a torsion balance. The weight was observed at any given moment by a periodic lowering of the lever. A rapid decrease in weight accompanies the evaporation of the surface water of the organisms. At the time of the transition to the evaporation of internal water, a brief stabilization of weight occurs. This moment characterizes the actual weight of the animal. The method indicated is suitable for fixed as well as unfixed material. (Auth.)

4745. Pora, Eugen A., C. Wittenberger, H. Kolassovits, and D. I. Rosca. 1959. RESEARCH ON THE VISUAL SENSITIVITY OF SOME FISH OF THE BLACK SEA. (CERCETĂRI ASUPRA SENSIBILITĂTII VIZUALE A CÎTORVA PESTI DIN MAREA NEAGRĂ.) Stud. si cercetari Biol. 10(2): 285-292. Illus.; Biological Abstracts, Vol. 36, No. 19, Abst. No. 62797. 1961.

Having studied the mechanism of vision in certain fish of the Black Sea, the authors have determined, in several species, the threshold at which the fish responds. To do this, they have used the Grundfest method which allows determination of the reaction of the fish to a point of light. The experiments have been carried out with white and colored light and with fish adapted to darkness. The thresholds of reaction to white light among the 10 reactive species used for experimentation (certain species are unreactive) are quite similar and seem closely related to those of the human eye. The lowest threshold was found with Engraulis encrassicholus Pontitus, typically nocturnal fish, while the highest was found with young Mugil, which live in the most intensely illuminated zone of water. The lowest threshold of reaction was manifested with green light. This threshold is very much lower than with white light, but is a little higher in yellow, still higher in orange and blue and very high in red. (Auth.)

4746. Vinogradov, M. E. 1959. THE QUESTION OF THE VERTICAL CLASSIFICATION OF MARINE ZOOPLANKTON. (K VOPROSU O VERTIKAL'NYKH GRUPPIROVKAKH MORSKOGO ZOOPLANKTONA.) Trudy Inst. Okeanol. Akad. Nauk SSSR 30: 100-106; Referat. Zhur., Biol., 1961, No. 5D678; Biological Abstracts, Vol. 36, No. 19, Abst. No. 62861. 1961.

A critical review of the classification of zooplankton according to the depth of the water they inhabit and the pattern of migration. They are classified: (1) epiplankton species, populating the surface or producing zone; (2) deep water species, inhabiting the deep, consuming zone; and (3) interzonal species, spending part of their life in the surface zone and part in the deep zone. The last group is divided into a group of upper-interzonal species - the whole feeding part of the population (mainly the young) belongs to this zone - and into a group of lower interzonal species, rising to the surface only for a short time, there being only an insignificant part of the population that completes migration. In temperate and polar seas, the first group makes up more than 50%, and sometimes even more than 90% of the general mass of plankton. Zooplankton can be separated according to the degree of the relationship between depth and migrating interzonal grouping: (a) deep-water species, connected by active food ties with the surface zone; (b) very deep-water species, not rising higher than 6,000 m. (Auth.)

4747. Armitage, Kenneth B. 1961. DISTRIBUTION OF RIFFLE INSECTS IN THE FIREHOLE RIVER, WYOMING. Hydrobiologia 17(1/2): 152-174; Biological Abstracts, Vol. 36, No. 19, Abst. No. 62867. 1961.

The river flows through the major hot springs basins of the Yellowstone National Park. Sampling stations were located above and below major influxes of hot spring water to determine the effect of the increase in temperature and pH on the insect fauna. Tables give the numbers and weight of the species found at each station. A number of species

are more abundant in the hotter areas, others are more abundant in the colder parts and other species show no temperature preference. The nature of the substrate and water flow are discussed in relation to the distribution of stream insects. Seasonal fluctuations brought to light are also discussed. (K. E. M.)

4748. Ozeretskoskaia, N. G., and N. F. Smirnova. 1959. HYDROCHEMICAL STUDIES ON THE PSEKUPS RIVER AND THE RESERVOIRS OF THE KRASNODAR REGION IN CONNECTION WITH FERTILIZATION. (GIDROKHIMICHESKIE ISSLEDOVANIIA R. PSEKUPS I PRUDOV KRASNODARSKOGO KRAIA V SVIAZI S UDOBRENIEM.) Trudy Zool. Inst. Akad. Nauk SSSR 26: 96-128. Referat. Zhur., Biol., 1961, No. 1D507; Biological Abstracts, Vol. 36, No. 19, Abst. No. 62875. 1961.

A hydrochemical characterization of the Psekups River and the fish-hatchery reservoirs which are fed by the waters of the Psekups River. The introduction of plant fertilizers resulted in both an improvement in the hydrochemical equilibrium of the reservoirs and a weakly expressed tendency to accumulate organic substances in the soil. The introduction of mineral fertilizers affected the gaseous equilibrium of the reservoir. The experimental introduction of complex fertilizers (organic and mineral) into the reservoirs gave positive results resembling the effect of mineral fertilizers on the equilibrium of the reservoirs. (Auth.)

4749. Peredel'skii, A. A., and I. O. Bogatyrev. 1959. THE SCATTERING OF RADIOACTIVE ISOTOPES BY AQUATIC INSECTS. (RASSEIVANIE RADIOIZOTOPOV VODNYMI NASEKOMYMI (REF. DOKL., PROCHIT. 24 DEK. 1958.) Biull. Mosk. Obshch. Ispytal. Prirody Otd. Biol. 64(2): 150. 1959; Referat. Zhur., Biol., 1961, No. 5D129; Biological Abstracts, Vol. 36, No. 19, Abst. No. 62876. 1961.

Coefficients of the accumulation and scattering of radioactive substances from artificially contaminated reservoirs by insects of different species, the larvae of which populate the bottom of the reservoirs, are different and are related to the type and concentration of the isotopes. When the bottom-dwelling insects leave the contaminated reservoirs, they are capable of carrying off to dry land a significant amount of radioactivity. The biological purification of the reservoirs may be limited by the peculiarities of peat formation. (Auth.)

4750. Røen, Ulrik. 1961. THE RELATIONSHIP BETWEEN SMALL CRUSTACEOUS PLANKTON AND THE AMOUNT OF PRODUCED ORGANIC MATERIAL IN GRANE LANGSØ 1950-51. (FORHOLDET MELLEM SMÅKREBSPLANKTON OG MAENGDEN AF PRODUCERET ORGANISK STOF I GRANE LANGSØ 1950-51.) Flora og Fauna 67 (1/2): 19-25. Illus. Biological Abstracts, Vol. 36, No. 19, Abst. No. 62879. 1961.

The present work is a continuation of the author's previous work on the entomostracfauna in the Jutlandish oligotrophic Lake Grane Langsø (Røen 1954). It is shown how the total number of plankton entomostraca fluctuates during a year from bottom to surface in a column of water; l these fluctuations have been put in relation to measurements of the primary production of the Lake, stated in g glucose/square meter surface/24 hours. (Auth.)

4751. Hopper, Arthur F. 1961. THE EFFECT OF FEEDING MAMMALIAN THYROID POWDER ON GROWTH RATES OF IMMATURE GUPPIES. Growth 25(1): 1-5; Biological Abstracts, Vol. 36, No. 19, Abst. No. 64700. 1961.

Thyroid powder may be administered to immature fish either by sprinkling it on the surface of the water with the food or by raising the fish in solutions of the powder. The latter method has been proven to be effective in increasing growth rates and stimulating earlier differentiation. In this paper an attempt was made to reproduce the earlier results using the method of administering the hormone with the food. No effect on growth rates or on sexual differentiation resulted from feeding thyroid powder to immature fish. A comparison was made between 2 methods of raising the fish, either in tanks with green plants where the fish were undisturbed during the course of the experiment, or in tanks without plants where the water was changed semiweekly. The latter experimental procedure had an inhibitory effect on growth and differentiation in both control and thyroid-fed fish. (Auth.)

4752. Vishnevskii, V. L. 1960. THE CYCLE OF PARASITIC FAUNA UNDER THE CONDITIONS OF NATURAL RESERVOIRS. (KRUGOVOROT PARAZITOV V USLOVIYAKH ESTESTVENNYKH VODOEMOV.) Trudy Gel'mintol. Lab. Akad. Nauk SSSR 10. 71-84; Referat. Zhur., Biol., 1961, No. 5E5; Biological Abstracts, Vol. 36, No. 19, Abst. No. 66230. 1961.

Parasitological studies of an entire biocenosis were made, using the Druzno and Goldapivo lakes (Mazurskii Lakes) as examples. Seventeen pathways of migration of trematodes are described, 9 of cestodes, and 1 of Acanthocephala. It is found that the distribution of host and parasite is more variable and the parasitic fauna more abundant in the mesotrophic waters than in the eutrophic. The regulatory influence of parasites on the biocenosis, as a rule, is not significant. (Auth.)

4753. Lapin, Yu. E. 1960. CHARACTERISTICS OF THE CHANGES IN THE NUMBERS OF FISH WITH A SHORT LIFE CYCLE, WITH THE EXAMPLE OF THE SMELT. (OSOBENNOSTI DINAMIKI CHISLENNOSTI RYB S KOROTKIM ZHIZNENNYM TSIKLOM NA PRIMERE SNETKA.) Zool. Zhur. 39(9): 1371-1383. Referat. Zhur., Biol., 1961, No. 5D430; Biological Abstracts, Vol. 36, No. 20, Abst. No. 66974. 1961.

The number captured from a stock of fish with a short life cycle depends on the yield of young, the

type of growth and the maturation of the younger generation. A study of these indices in the smelt showed that a school of this fish can exist in various stages depending on the environmental conditions (conditions of spawning and the food supply of the reservoir during each year): (1) spawning stock of uniform age; smelt small and numerous; this type of school can withstand extensive commercial operations; (2) spawning stock consists of 2-3 age groups, the older predominating. Such a school will not sustain intensive commercial fishing. Regulation of smelt fishing in relation to the condition of the stock is suggested. (Auth.)

4754. Baggerman, Bertha. 1960. FACTORS IN THE DIADROMOUS MIGRATIONS OF FISH. Symposia Zool. Soc. London 1. 33-60, Illus.; Biological Abstracts, Vol. 36, No. 20, Abst. No. 67857. 1961.

On the basis of available information it is concluded that before migration occurs a change takes place in the physiological condition of the animals rendering them susceptible to appropriate external factors "releasing" migration. The changes in physiological condition comprise changes in secretory activity of endocrine systems, of which the pituitary, thyroid, gonads and interrenal tissue seem to be the most important glands involved. The hormones may directly affect migratory behavior, or induce changes in physiological components such as osmoregulation, metabolism and sensory perception, which in their turn may affect migration. The changes in endocrine activity are controlled by external "priming" factors such as the length of the daily photoperiod and temperature, and by endogenous rhythms. In animals in which the proper physiological condition has been induced various external stimuli like temperature, light intensity, river discharge and meteorological factors are able to "release" migration. (Auth.)

4755. Doyle, William L., and Donna Gorecki. 1961. THE SO-CALLED CHLORIDE CELL OF THE FISH GILL. Physiol. Zool. 34(2): 81-85, Illus.; Biological Abstracts, Vol. 36, No. 20, Abst. No. 68803. 1961.

The distribution of a specialized cell, commonly known as the chloride cell, has been reexamined using the electron microscope. These cells were found in a marine elasmobranch, Urobatis; the euryhaline species, Fundulus and Tilapia; the guppy, Lebistes; the minnow, Notropus. The cell is characterized by the presence of numerous large mitochondria and by a branching, tubular endoplasmic reticulum of rather constant diameter. The endoplasmic reticulum is devoid of dense granules and its tubules are found to communicate with the cell membrane in some species. The authors conclude that their findings cast doubt on the supposed role of these cells in the chloride exchange known to occur in the gill. (Auth.)

4756. DeBuen, Fernando. 1960. THE TOAD-FISH FAMILY GOBIESOCIDAE IN CHILE. (LOS PEJE-SAPOS (FAMILIA GOBIESOCIDAE) EN CHILE.) Rev. Biol. Marina 10(1/3): 69-82, Illus.; Biological Abstracts, Vol. 36, No. 20, Abst. No. 70419. 1961.

The toad-fish family (Gobiesocidae), of special interest to physiologists, from the rocky, tidal zones of Chile is discussed, with a key to genera and sp. Separation is made primarily on the morphological characteristics of the adhesive disc, a diagram of Sicyases sanguineus being included. Detailed descriptions and synonyms are given of that sp. and of S. hildenbrandi, Gobiesox marmoratus and Tomicodon chilensis, although the latter is not so described. There is a check list of other spp. in 10 families which are associated in the tidal zone. These are grouped as permanent and as temporary inhabitants. (G. W. P.)

4757. Hubbs, Clark, and Martha V. Johnson. 1961. DIFFERENCES IN THE EGG COMPLEMENT OF HADROPTERUS SCIERUS FROM AUSTIN AND SAN MARCOS. Southwestern Nat. 6(1): 9-12; Biological Abstracts, Vol. 36, No. 20, Abst. No. 70424. 1961.

Eggs of Hadropterus scierus from near Austin, Texas, are smaller and more numerous than those from near San Marcos. The increased egg diameter correlates directly with intensity of interspecific competition and correlates inversely with intraspecific competition. (Auth.)

4758. McAllister, D. E. 1960. A COLLECTION OF OCEANIC FISHES FROM OFF BRITISH COLUMBIA WITH A DISCUSSION OF THE EVOLUTION OF BLACK PERITONEUM. Natl. Mus. Canada Bull. 172, pp. 39-43; Biological Abstracts, Vol. 36, No. 20, Abst. No. 70428. 1961.

The unusual collection of fishes from about 340 mi. W. of Union Island, Kyuquot Sound, Vancouver Island, B. C., collected between the surface and 60 m depth, is described. They include 2 spp. of Argentinidae, 2 of Malacosteidae, and 3 of Myctophidae. Despite the phylogenetic differences between them, they all shared 1 feature in common, the possession of a black peritoneum. Other reports of this coloration are reviewed which is not uncommon in bathypelagic fishes. It also occurs in several genera of the phytophagous Cyprinidae, whereas zoophagous Cyprinidae have silver or speckled peritoneum. It probably serves a function in both cases: in the bathypelagic fishes, to prevent the light of the luminescent plankton which they eat from shining through their sides and revealing their position to a predator; in the phytophagous cyprinids, because light (from sunlight) may be detrimental to digestion of plant materials (possibly by killing bacteria useful to digesting cellulose). (Auth.)

4759. McAllister, D. E., and C. C. Lindsey. 1960. SYSTEMATICS OF THE FRESHWATER SCULPIN (COTTUS) OF BRITISH COLUMBIA. Natl. Mus. Canada Bull. 172, pp. 66-89; Biological Abstracts, Vol. 36, No. 20, Abst. No. 70430. 1961.

Descriptions of the characters and geographic variation of 6 spp. from British Columbia are presented. Characters, counts, and proportions are given in a consistent format. New characters, the shape of prickles, and the number of spines on the 1st dorsal basal were found to be of significance. Synonymies are presented, including n. syns. C. cognatus Richardson (= C. chamberlaini Evermann and Goldsborough= C. philonips Eigenmann and Eigenmann= C. kaganowskii Berg). Coastal specimens of C. asper were found to differ significantly from inland specimens. Intraspecific variation was examined in 148 collections of C. cognatus from northern North America. Evidence is presented of survival in 2 or possibly 3 glacial refuges, 1 N.-W. of, and 1 or 2 S. of the Pleistocene ice-sheet. The relationships of British Columbia freshwater sculpins to one another and to some extralimital spp. are discussed. (Auth.)

4760. Girsa, I. I. 1960. EFFECT OF VARYING ILLUMINATION ON THE ACCESSIBILITY OF FOOD ORGANISMS FOR CERTAIN FISH. (VLIYANIE RAZLICHNOI OSVESHCHENNOSTI NA DOSTUPNOST' KORMOVYKH ORGANIZMOV DLYA NEKOTORYKH RYB.) Trudy Inst. Morfol. Zhivotnykh Akad. Nauk SSSR 13, pp. 118-128; Referat. Zhur., Biol., 1961, No. 6D292; Biological Abstracts, Vol. 36, No. 21, Abst. No. 70871. 1961.

A qualitative determination was made of the rate of consumption of food organisms by fish at different intensities of illumination and in total darkness. In these experiments, Leucaspius and Carassius were fed on Daphnia; Gadus and Pollachius were fed on Gammarus and Harpacticoids. Accessibility of the food organisms for the fish was determined under various conditions by a direct count of the organisms consumed, by recording the time required for the fish to detect one kind of organism, and by direct observation of the behavior of Gadus and Pollachius under these conditions. The experiments showed that the feeding of the visual planktonophagic organisms Pollachius and Leucaspius both continued at the highest level in daylight up to an illumination of 3-5 lux. As light intensity decreased, there was a sharp drop in the activity of these fish, and at an intensity of less than 0.001 lux the active pursuit of food organisms stopped completely. Gadus can detect Gammarus visually at 0.01 lux, while Pollachius fails to detect it below 0.1 lux. (Auth.)

4761. Smirnov, N. N. 1961. DISSOLVED VITAMINS AND THEIR IMPORTANCE FOR AQUEOUS ORGANISMS. (RASTVORENNYE VITAMINY I IKH ZNACHENIE DLYA VODNYKH ORGANIZMOV.) Biull. Inst. Biol. Vodokhranilishch 4: 21-25; Referat. Zhur., Biol., 1961, No. 6D3; Biological Abstracts, Vol. 36, No. 21, Abst. No. 70927. 1961.

Almost all water soluble vitamins can be detected in the water. The source of these vitamins is the organisms which synthesize them. Dissolved vitamins are a determining factor in the "yield" of many algae and flagellates, both in the sea and in fresh water, and thus have a strong effect on the food base of animals. The author suggests that the dissolved vitamins also affect the behavior of animals. (Auth.)

4762. Meshkova, T. M. 1960. CHANGES IN THE FAUNA OF LAKE ARPILICH IN CONNECTION WITH ITS TRANSFORMATION INTO A RESERVOIR. (IZMENENIE FAUNY OZERA ARPILICH V SVYAZI S PREVRASHCHENIEM EGO V VODOKHRANILISHCHE.) Zool. Zhur. 39(11): 1597-1606; Referat. Zhur., Biol., 1961, No. 6D522; Biological Abstracts, Vol. 36, No. 21, Abst. No. 70933. 1961.

The Arpilich reservoir (in the northwestern part of the Armenian SSR), created for purposes of irrigation, appeared in 1952 as the result of damming of the Akhuryan river flowing out of Lake Arpilich. Before this, the lake had been a shallow eutrophic body of water, overgrown with higher aqueous vegetation. The biomass of zooplankton was approximately 8 g/m^3. The zoobenthos was qualitatively varied, but quantitatively poor (average biomass of 3.6 g/m^2). Commercially, the most significant were the carp, bullhead and "khramulya". After the water level rose, all the higher aqueous vegetation died, and due to the great turbidity of the water the quantity of phytoplankton decreased and "blooming" stopped. The previously predominant facultative planktonic types disappeared from the zooplankton, but the amount of zooplankton was still quite large (biomass of approximately 1 g/m^3). As the result of the slow silting up of the reservoir and the constant agitation, the zoobenthos became qualitatively poorer, dominated by oligochaetes and Tendipedidae larvae, and the biomass of the benthos decreased sharply to 0.1 g/m^2. The only commercially significant component at the present time, the carp, began to feed primarily on plankton. In view of the slow accumulation of organic substances, the food base of the carp will henceforth be very limited. Measures are recommended which would make possible increased biological productivity of the reservoir. (Auth.)

4763. Ali, A. Maher, et al. 1958. A NOTE ON THE TOXICITY OF INSECTICIDES TO AQUATIC FAUNA. Agric. Res. Rev. 36(1): 159-165; Biological Abstracts, Vol. 36, No. 21, Abst. No. 70941. 1961.

The insecticides tested can be arranged as follows in order of their toxicity to fishes: DDT, toxaphene, Gusathion, chlordane in concentration less than 8 ppm, lindane, chlordane in concentration more than 8 ppm, Systox, Meta-Systox. Although chlorinated compounds seem to be more toxic to fishes than organo-phosphorous compounds, the time between reaction to the insecticide and death is shorter with the latter compounds. (Auth.)

4764. Borutskii, E. V. 1960. THE FOOD SUPPLY. (O KORMOVOI BAZE.) Trudy Inst. Morfol. Zhivotnykh Akad. Nauk SSSR 13: 5-61;

Biological Abstracts, Vol. 36, No. 21, Abst. No. 70944. 1961.

A theoretical summary of contemporary ideas on the food supply of fish. The author considers predator-prey relationships within a body of water which determine the food supply of the reservoir. The relationships between fish and their prey, between the various kinds of prey, and between both fish and prey and their respective parasites, are examined in detail. The problem of the availability of the food base of the fish is considered in relation to the hydrological conditions in the body of water, the morphobiological characteristics of the fish themselves and of the organisms serving them as food, and the type of distribution and the density of both the sources of food and the fish consuming it. The terminology of certain concepts used in the problem of fish nutrition is clarified. Bibliography with 332 references. (Auth.)

4765. Egorov, A. G. 1960. ACCLIMATIZATION OF MIRROR AND SCALED CARP IN BODIES OF WATER OF THE IRKUTSK OBLAST AND THE BURYAT ASSR. (AKKLIMATIZATSIYA ZERKAL' NOGO I CHESHUICHATOGO KARPA V VODOE - MAKH IRKUTSKOI OBLASTI I BURYATSKOI ASSR.) Voprosy Ikhtiol. 14: 156-159; Referat. Zhur., Biol., 1961, No. 7D423; Biological Abstracts, Vol. 36, No. 21, Abst. No. 70951. 1961.

Projects for the release of mirror and scaled carp in the Irkutsk Oblast were initiated in 1941. In the fall of 1949, 29 spawners of mirror and scaled carp and Amur wild carp from the Krasnoyarsk Oblast fish hatchery were released into Lake Ordynskoe. The first brisk spawning was observed in June 1950. In 1951 carp were caught which were aged 1+, in the fall of that year they weighed 350-500 g or more, and a year later 500-800 g. Sexual maturity was attained by the carp in this lake in the fifth year of life. The first mass spawning by locally-born fish was observed in 1955. Breeders have been transferred to the Buryat ASSR from Lake Ordynskoe. (Auth.)

4766. Nikol'skii, G. V., B. V. Verigin, and O. N. Klyuchareva. 1960. THE FISH INDUSTRY OF THE MIDDLE AND UPPER AMUR IN RELATION TO HYDRO-CONSTRUCTION PLANS. (O RYBNOM KHOZYAISTVE SREDNEGO I VERKHNEGO AMURA V SVYAZI S NAMECHAEMYM GIDROSTROITEL'-STVOM.) Zool. Zhur. 39(3): 407-416; Referat. Zhur., Biol., 1961, No. 7D420; Biological Abstracts, Vol. 36, No. 21, Abst. No. 70970. 1961.

Measures for building up the ichthyofauna of future reservoirs are designated, as well as ways of creating better conditions for the reproduction, nutrition, and hibernation of the future inhabitants of these reservoirs. (Auth.)

4767. Power, G. 1961. SALMON INVESTIGATIONS ON THE WHALE RIVER, UNGAVA IN 1960 AND THE DEVELOPMENT OF AN ESKIMO FISHERY FOR SALMON IN UNGAVA BAY. Arctic 14 (2): 119-120; Biological Abstracts, Vol. 36, No. 21, Abst. No. 70972. 1961.

A study of Atlantic salmon breeding in the Ungava Bay watershed, begun in 1956, was continued in 1960 on the Whale River. Almost 900 specimens were examined, 185 adults, 32 spent fish from the previous year and the rest juvenile smolts and parr. Spawning run in the river began about Aug. 6 and continued to the end of the month. Most salmon in the run were between 9 and 13 lbs. and had spent 2 or more years feeding at sea. Grilse, after 1 or more years at sea, were between 3.5 and 6 lbs. Juveniles migrate to the sea when 3 to 7 years old and 18 to 26 cm long. Data collected have been used in establishing an Eskimo fishery on the Ungava Bay watershed, with fresh salmon being flown from Chimo to Montreal for sale. (W. W. J.)

4768. Buhler, Donald R., and John E. Halver. 1961. NUTRITION OF SALMONOID FISHES. IX. CARBOHYDRATE REQUIREMENTS OF CHINOOK SALMON. Jour. Nutrition 74(3): 307-318; Biological Abstracts, Vol. 36, No. 21, Abst. No. 71426. 1961.

Using an adequate protein, vitamin and fat source in the test diet, the effect of different levels of dextrin, alpha-cellulose and fat were studied with Chinook salmon (Oncorhynchus tshawytscha) fingerlings. No appreciable difference in fish growth for diets of 0-48% dextrin and no alpha-cellulose were observed and no deleterious affect of high carbohydrate levels upon growth or health was found. When alpha-cellulose was varied inversely with dextrin, growth was retarded at high alpha-cellulose concentrations, perhaps as a result of increased bulk. Low alpha-cellulose increased protein efficiency but fat substituted for dextrin lowered growth and protein synthesis. Increased dextrin showed increased liver glycogen and moderate hypertrophy but gave no excessive fat. In another study, glucose, maltose, dextrin, potato starch, sucrose, fructose, galactose and glucosamine were used as carbohydrate sources. Fish growth rate was found to decrease with increased molecular weight. Sucrose could substitute for glucose, fructose was 80% effective, galactose was 60% effective and glucosamine less than 50% effective as sole carbohydrate sources for salmon fingerlings. (Auth.)

4769. Marshall, A. J. 1960. REPRODUCTION IN MALE BONY FISH. Symposia Zool. Soc. London 1: 137-151; Biological Abstracts, Vol. 36, No. 21, Abst. No. 71886. 1961.

The remarkable convergence in reproduction behavoir between birds and certain groups of bony fishes is discussed. In the testes of Osteichthyes two distinct glandular arrangements occur (a) interstitial Leydig cells, which arise from intertubular connective tissue; and (b) lobule boundary cells, which arise from fibroblasts surrounding the seminiferous tubules. The interstitial arrangement typical of vertebrates is found in Petromyzon, many bony fishes (including Latimeria and the

Dipnoi), in elasmobranchs, and in the Anura, Reptilia, Aves and Mammalia. The boundary cell arrangement has been demonstrated to occur in certain bony fishes, and will be found in many more when it is specifically looked for. The occurrence or otherwise of one of these different glandular arrangements may provide a useful tool in fish taxonomy. Although the Anura possess interstitial cells, the Urodela (as far as is known) have boundary cells. Purely speculative remarks are made concerning possible phylogenetic implications of these phenomena. Bony fishes, like birds, have adapted implications themselves to a variety of external factors in the regulation of their reproduction cycles. Some equatorial species breed all the year round but the cycles of others are rigidly controlled. The phenomenon known as "runting" is mentioned briefly. (Auth.)

4770. Olivares Villegas, Teresa. 1958. PIGMENTATION MECHANISMS IN FRESH WATER FISH. (MECANISMOS DE LA PIGMENTACION EN PECES DE AGUA DULCE.) Zooiatria 8(27/30): 40-50; Biological Abstracts, Vol. 36, No. 21, Abst. No. 72010. 1961.

Gambusia affinisholbruki responds to light stimuli as follows: in a dark medium, with direct light, they darken by melanophoric expansion. In white media with diffused light they lighten with chromatophoric retraction. The mechanism of pigmentary accommodation is made up of a reflex arc whose peripheral reflector is represented by the eye, which through deep connections unlocks the neuro-humoral reflex, which would be responsible for the responses. Unilateral enucleation of the eye does not modify the pigmentary adaption; on the other hand, the bilaterla one suppresses the reflex of pigmentary adaptation. ACTH is a melanin expansor, in light as well as dark media. Adrenalin maintains a general tone in intermediate limits between the light and dark media. Cortisone had a significant melanin expansor effect which has yet to be explained. In isolated scales, the effect of the hormone is very slight due, probably, to their impermeability. (Auth.)

4771. Fischer, Walter K. 1959. EGGS, DEVELOPMENT AND EARLY LARVAL STAGES OF MERLUZA (MERLUCCUS GAYI) GUICHENOT. (HUEVOS, DEVELOPMENT Y PRELARVAS DE LA MERLUZA, (MERLUCCUS GAYI), GUICHENOT.) Rev. Biol. Marina 9(1/3): 229-249; Biological Abstracts, Vol. 36, No. 21, Abst. No. 74477. 1961.

Eggs of Merluccus were hatched in the laboratory and early stages studied, as were also larvae collected from the plankton near the Valparaiso coast. The eggs and the embryonic development in 5 phases are described in detail, including internal anatomy. Eleven-day larvae, 8 mm long were the most advanced stages studied. The larvae are characterized and easily identified by a diffused yellow pigment in addition to a black pigment. There are also orange-colored pigment bodies in close relationship with the melanophores. The characteristics which only slightly differentiate this species from others in the genus are described, using egg-size and rate of growth for comparison. There is a short bibliography of 7 entries. (G. W. P.)

4772. Lozano Cabo, Fernando. 1960. APPLICATION OF FAUNISTIC REASONING TO DETERMINATION OF THE LIMITS BETWEEN THE MARINE AND FLUVIATILE DOMAINS. (APLICACIÓN DEL RAZONAMIENTO FAUNISTICO A LA DELIMITACIÓN ENTRE LOS DOMINIOS MARINOSY FLUVIAL.) Bol. R. Soc. Española Hist. Nat. Biol. 58(1): 175-184; Biological Abstracts, Vol. 36, No. 22, Abst. No. 75002. 1961.

In Spanish freshwater rivers there are 14 species of indigenous, 13 species not exclusively Spanish, and 6 imported species of fish. These are characterized as stationary or stable species. Six species are listed which hatch in the rivers but develop in the seas. They are discussed individually. They do not belong to either domain exclusively. Only 1 species, an eel, belongs to the group which hatch in the sea and develop in the rivers. The 4th group of truly marine species is represented by 32 species of fish, 17 species of mollusk, 8 of crustaceans, 2 of worms, and 4 of algae. The limit between the marine and fluviatile domains is marked by the line of contact between their respective "stationary" faunas. The area of dispersal of the stationary fluviatile fauna is that of the Cyprinidae, which are genuine representatives of the Spanish freshwater fauna, which never stay in waters below the level reaches by the highest tides in the river basins. In other words, any part of a river which is affected by the tides should be considered marine. (Auth.)

4773. Grimal'skii, V. D. 1959. ZOOPLANKTON OF THE DNIESTER AND CHANGES IN THE ZOOPLANKTON IN THE ENVIRONMENT OF THE DUBOSSARSK RESERVOIR. (ZOOPLANKTON DNESTRA I EGO IZMENENIYA V USLOVIYAKH DUBOSSARSKOGO VODOKHRANILISHCHA.) Trudy VI Soveshchaniya Po Problem. Biol. Vnutren. Vod. 1957, pp. 365-370; Referat. Zhur., Biol., 1961, No. 5D702; Biological Abstracts, Vol. 36, No. 22, Abst. No. 75014. 1961.

The environmental conditions of the zooplankton of the Dniester are characterized by very muddy water, moderate mineralization and hardness of water, and an insignificant quantity of biogens. Rotifera were predominant in the plankton (95.7 - 100% of the general population). Up to 40% of the forms were benthic plankton. The greatest number of zooplankton appeared in August and September. The relative scarcity of the zooplankton is dependent on the muddiness and the weak development of phytoplankton. The Dubossarsk Reservoir, originating in the Kamenk-Dubossara section, is distinguished by a significant transparency, a high content of dissolved oxygen and a relatively high nitrate content. In the zooplankton of the Reservoir a

decrease in benthic forms occurs, and there is an active development of crustaceans, which make up 48-49% of the general population. A significant increase in number and a rise in the food value of the zooplankton is observed. (Auth.)

4774. Kasymov, A. G. 1959. BENTHIC FAUNA OF THE MINGECHAURSK RESERVOIR. (BENTOFAUNA MINGECHAURSKOGO VODOKHRANILISHCHA.) Trudy VI Soveshchaniya Po Problem. Biol. Vnutren. Vod. 1957: 473-477; Referat. Zhur., Biol., 1961, No. 5D699; Biological Abstracts, Vol. 36, No. 22, Abst. No. 75018. 1961.

Quantitative samples of benthos, during the different seasons of 1955 and 1956, from four sections showed that the benthos consisted of 29 species. Qualitatively and quantitatively Tendipedid larvae predominate. Procladius, and Cryptochironomus larvae are the most abundant of the group. Among the Oligochaeta, Tubifex tubifex predominates. The most productive areas with respect to food are the lower section of the reservoir and the Khanabad Gulf, the remaining part of the reservoir being less abundant in benthos due to turbidity of the water and very poor hydrochemical conditions. The average biomass of benthos is 0.2-5.3 g/m^2. Due to insufficient food the fish on the bottom are forced to feed on the remains of flooded terrestrial vegetation and plankton. (Auth.)

4775. Lokhanina, L. A. 1959. PRELIMINARY DATA ON THE FORMATION OF THE ZOOPLANKTON IN THE GOR'KOVSK RESERVOIR. (PREDVARITEL'NYE DANNYE O FORMIROVANII ZOOPLANKTONA GOR'KOVSKOGO VODOKHRANILISHCHA.) Trudy VI Soveshchaniya Po Problem. Biol. Vnutren. Vod. 1957: 340-346; Referat. Zhur., Biol. 1961, No. 5D701; Biological Abstracts, Vol. 36, No. 22, Abst. No. 75020. 1961.

Before the creation of the Gor'kovsk Reservoir, 15 species of Rotifera, 4 species of Cladocera and 4 species of Copepoda were prevalent in the Volga River. With the formation of the Reservoir, the number of species of zooplankton began to increase due to some limnophilic forms, although in general the river characteristics were preserved in regard to composition. A jump in the quantitative development of zooplankton occurred simultaneously, with an approximately two to four-fold increase in biomass. (Auth.)

4776. Lubyanov, I. P. 1959. SOME PRINCIPLES OF THE DYNAMICS OF BOTTOM-DWELLING FAUNA OF SMALL RIVERS IN THE STEPPES OF THE UKRAINE IN RELATION TO THE PRESENCE OF A SERIES OF RESERVOIRS. (NEKOTORYE ZAKONOMERNOSTI DINAMIKI DONNOI FAUNY MALYKH REK STEPNOI ZONY UKRAINY V SVYAZI S NALICHIEM NA NIKH KASKADA VODOKHRANILISHCH.) Trudy VI Soveshchaniya Po Problem Biol. Vnutren. Vod. 1957: 441-446; Referat. Zhur., Biol., 1961, No. 5D700; Biological Abstracts, Vol. 36, No. 22, Abst. No. 75021. 1961.

Reservoirs and non-regulated parts along the Psel River were studied from 1953 to 1955, over a distance of 400 km from the city of Suma to the Dnieper. Five water-way type Reservoirs were examined: Nizovsk, Bobrovsk, Veliko-Bogachsk, Belotserkovsk and Ostap'evsk. A great quantity of organic substances and a deficiency of O_2 are characteristic. The two upper Reservoirs, Nizovsk and Bobrovsk, are more silt-covered and filled with macrophytes than the others. Pelophilic and phytophilic animals predominate among the bottom-dwelling fauna. The Oligochaeta, Tubificidae, mollusks and Tendipedid larvae are the principal representatives. The bottom-dwelling population of the upper reservoirs is the richest, mainly due to mollusks. In the lower Ostap'evsk Reservoir, the fauna was richest on the prairie vegetation in the freshly watered zone. Along the non-regulated parts of the Psel River, the amount of O_2 is favorable, sandy soil predominates, and mud and overgrowth of macrophytes are observed in still places. Psammorheophilic and pelorheophilic biocenosos predominate; in the latter were observed the greatest number and mass of the bottom-dwelling fauna. Invertebrate fauna of the Caspian type of estuarial complex (nine species) live only in the lower current of the Psel River. It is advisable to enrich the food base of fish by placing in the reservoirs invertebrates, not present there already, which possess a high productive capacity. (Auth.)

4777. Barsukov, V. V. 1960. SYSTEMATICS OF CHUKOT CHARS OF THE GENUS SALVELINUS. (K SISTEMATIKE CHUKOTSKIKH GOL'TSOV RODA SALVELINUS.) Voprosy Ikhtiol. 14: 3-17; Referat. Zhur., Biol., 1961, No. 7D382; Biological Abstracts, Vol. 36, No. 22, Abst. No. 78585. 1961.

The three groups of chars from Lavrentiya Gulf, adjacent lakes, and from Lake Estikhet (Chukotka), and also, apparently, S. taranetzi Kaganowsky, belong to a single species, S. malma (Walbaum), and the latter is regarded as no more than a sspp. (synonym, group of subspecies?) of S. alpinus. The separation of the chars from Lake Estikhet into the separate sp. S. andriashevi Berg and its association with S. leucomaenis is based only on an error in the count of the gill rakers. (Auth.)

4778. Ivlev, F. S. 1960. REARING THE YOUNG OF THE BALTIC SALMON. (VYRASHCHIVANIE MOLODI BALTIISKOGO LOSOSYA.) Rybnoe Khoz. 2: 12-16; Referat. Zhur., Biol., 1961, No. 4D519; Biological Abstracts, Vol. 36, No. 22, Abst. No. 78593. 1961.

When alevins of the Baltic salmon were set free in the river, their survival rate to the smolt stage amounted to 0.21%. Release of young fry (up to 1.7 g) increased the survival rate 26 times (to 5.5%). The young fish were reared up to a weight of 1.5-1.7 g in ponds at a water temperature of 24-25° C. After the release of the young fish into the river at the end of June, the ponds can be used for the rearing of carp born the same year. For this

purpose, the late spawning of the carp must be controlled. From 1 hectare of pond surface, one can obtain 20,000 one-year-old carp, each weighing 25 g, and 20,000 young salmon each weighing 1.5 g. (Auth.)

4779. Larrañeta, M. Gómez. 1960. PROBLEMS IN THE EVALUATION OF POPULATIONS OF PELAGIC FISH. (PROBLEMAS EN LA EVALUACIÓN DE POBLACIONES DE PECES PELÁGICOS.) Bol. R. Soc. Española Hist. Sect. Biol. 58(2): 283-288; Biological Abstracts, Vol. 36, No. 22, Abst. No. 78598. 1961.

Various methods of estimating the volume of populations of fishes subjected to weighing are briefly described, noting the difficulties due to variations in vulnerability, relative concentration, weather, availability, conditions of aggregation, etc. Greater attention to conditions of aggregation is suggested. (Auth.)

4780. Rodríguez-Roda, Julio. 1960. CONSIDERATIONS ON THE BIOLOGY OF T. THYNNUS FROM BARBATE (SOUTH ATLANTIC COAST OF SPAIN). (CONSIDERACIONES SOBRE LA BIOLOGIA DEL ATÚN, THUNNUS THYNNUS (L.), DE BARBATE (COSTA SUDATLÁNTICA DE ESPÁNA).) Bol. R. Soc. Española Hist. Nat. Sect, Biol. 58(2): 347-362; Biological Abstracts, Vol. 36, No. 22, Abst. No. 78603. 1961.

Measurements of size and weight of specimens, total numbers of fish taken, percentage distribution of weights, proportions of the sexes in different months, numbers of gill-rakers, are tabulated and charted in various ways. (Auth.)

4781. Bogatyrev, I. O. 1959. DISTRIBUTION OF CERTAIN RADIOISOTOPES IN THE WATER, MUD AND PLANTS OF A CONTAMINATED RESERVOIR. (RASPREDELENIE NEKOTORYKH RADIOIZOTOPOV ZAGRYAZNENNOGO VODOEMA V VODE, ILU I RASTENIYAKH.) Biull. Moskov. Obshchestva Ispytatelei Prirody Otd. Biol. 64(2): 150; Referat. Zhur., Biol., 1961, No. 6D512; Biological Abstracts, Vol. 36, No. 23, Abst. No. 79088. 1961.

An experimental study of the distribution of a mixture of products of nuclear fission and the radioactive isotopes Cs^{137}, Ru^{106}, Sr^{90} and Co^{60} in the water, mud, sand and vegetation. The most active accumulators of radioactivity were the mud and aquatic plants. Sr^{90} penetrated poorly from the water into the other components of the reservoir. The aquatic plants were characterized by a high absorption of Co^{60}. (Auth.)

4782. Derzhavin, A. N. 1959. THE FORMATION OF THE MINGECHAUR RESERVOIR OF THE KURA RIVER. (STANOVLENIE MINGECHAURSKOGO VODOKHRANILISCHA NA R. KURE.) Trudy VI Soveschaniya po Problem. Biol. Vnutren. Vod. 1959: 467-472; Referat. Zhur., Biol., 1961, No. 2D681; Biological Abstracts, Vol. 36, No. 23, Abst. No. 79090. 1961.

The area of the Mingechaur reservoir is 620 km^2. A characterization of its hydrologic pattern is given. The salt composition of the Mingechaur reservoir is still in the formative stage. The plant and animal universe is very meagre, due to the poverty of the inflow of biologic resources into the Mingechaur reservoir. As a result of great seasonal and yearly fluctuations in the water level, macrophytes are lacking. The phytoplankton and microphytic benthos are quite diversified (250 forms). Thirteen species make up the zooplankton; its biomass does not exceed 2 g/m^3. There are 29 species in the benthos; the biomass of the benthos ranges from 0.82-5.29 g/m^2. There is actually only one pelophylic biocoenesis, dominated by oligochaeta and tendipedid larvae. Almost all the fish in the Mingechaur reservoir are native species, which inhabit the channel and accessory basins of the lower course of the Kura. The only transient fish encountered are the young of the salmon and a few other fish. In connection with the small resources of benthos, benthophagic fish have shifted to a diet of plankton and remains of terrestrial vegetation brought in by the inundations and partially, too, to a carnivorous diet. The creation of the Mingechaur reservoir, which acts to regulate the discharge of the Kura and to transform its pattern at the lower bluff, has exerted an enormous influence on the reproduction of fish reserves in the Kura. Disruption of the summer migrations of sturgeon fish has occurred, and they have almost ceased to ascend to Mingechaur; the change in the temperature balance has caused a displacement of the spawning times of thermophilic fish from spring and early summer to the second half of the summer or to autumn. Indigenous conditions for the propagation of sturgeon fish have become worse. (Auth.)

4783. Wigley, Roland L. 1961. BOTTOM SEDIMENTS OF GEORGES BANK. Jour. Sediment Petrol. 31(2): 165-188; Biological Abstracts, Vol. 36, No. 23, Abst. No. 79080. 1961.

Determinations of particle size composition, organic content, shell content and color were made on samples from more than 200 stations, providing basic data to be used in studying the relationship between substrate composition and the occurrence of benthic animals, especially those which are common food of fishes. (H. S. L.)

4784. Farmer, Joe A. 1960. THE EFFECTS OF INDUSTRIAL AND DOMESTIC POLLUTION ON THE BLACK WARRIOR RIVER ON THE NET-PLANKTON POPULATION. Jour. Alabama Acad. Sci. 31(6): 447-458; Biological Abstracts, Vol. 36, No. 23, Abst. No. 79091. 1961.

Through the period from February 26 to July 1, 1955 net-plankton samples were taken from a station located in relatively non-polluted water and from a station in extremely polluted water Flagellate protozoa, diatoms, and filamentous green algae showed highest sensitivity to pollution of any groups, while rotifers, Sarcodina and Volvocales

were most tolerant. Phytoplankters were generally more adversely affected by pollution than were zooplankters. The greatest populations of total plankters and of most groups and the greatest differences between sampling stations occurred during low water periods. (J. C. O.)

4785. Kozhov, M. M., and N. V. Tyumentsev. 1960. THE BIOLOGICAL CONSEQUENCES OF FLUCTUATIONS IN THE LEVEL OF LAKE BAIKAL. (O BIOLOGICHESKIKH POSLEDSTVIYAKH KOLEBANII UROVNYA BAIKALA.) Biull. Moskov. Obshchestva Ispytatelei Prirody Otd. Biol. 65(4): 149-150; Referat. Zhur., Biol., 1961, No. 6D471; Biological Abstracts, Vol. 36, No. 23, Abst. No. 79094. 1961.

A drop in the water level of Lake Baikal leads to a significant decrease in fish reserves and has a negative effect on the fauna of the littoral. (Auth.)

4786. Mel'nikov, G. B. 1959. THE FORMATION OF THE BIOLOGIC PATTERN OF THE SIMFEROPOL' RESERVOIR. (STANOVLENIE BIOLOGICHESKOGO REZHIMA SIMFEROPOL' VODOKHRANILISHCHA.) Trudy VI Soveshchaniya po Problem Biol. Vnutren. Vod 1959: 459-463; Referat. Zhur., Biol., 1961, No. 2D678; Biological Abstracts, Vol. 36, No. 23, Abst. No. 79098. 1961.

The Simferopol' reservoir is a lake-like oligotrophic basin with a surface area of 320 hectares and a maximal depth of 37 m. The macrophytic overgrowth is scanty, the phytoplankton numerous (40 species) and qualitatively poor; oligosaprobe diatoms predominate. The zooplankton is scanty (maximal biomass in May, 1.06-2.24 g/m^3; in summer, 0.264-0.622 g/m^3). The leading species are Cyclops vicinus, Acanthocyclops vernais, Daphnia longispina, D. hyalina, and Bosmina longirostris. The bottom fauna is quantitatively and qualitatively poor. The seasonal dynamics of the bottom fauna were followed from the spring of 1955 to the spring of 1956. Irregular distribution of the fauna was observed, depending on the character of the bottom. In 1955, the richest in fauna were argillaceous and calcareous bottoms of the profundal (biomass up to 22.52 g/m^3), due to the presence of oligochaeta, gilled molluscs, and tendipedid larvae. The poverty of the fauna and flora of the Simferopol' reservoir is due to the meagre intake of biogenic substances, which limits the accumulation of organic substances, and their rapid mineralization; to the continuous inflow of cold water; to the poverty of the original bio-resources; and to historical principles (insular character of the Crimean fauna). It is proposed to undertake mineral and organic fertilization of the basin, to establish foci of mass propagation of zooplankton of the "daphnia pits" (sic) type; and to acclimatize various food invertebrates. Stocking with fish should be carried out with great care, owing to the limitations of the food resources. Commercial species of fish should be forbidden for 2-3 years. (Auth.)

4787. Naberezhnyi, A. I. 1959. FEATURES OF THE FORMATION OF THE HYDROBIOLOGIC PATTERN IN THE DUBOSSARSK RESERVOIR. (OSOBENNOSTI FORMIROVANIYA GIDROBIOLOGICHESKOGO REZHIMA V DUBOSSARSKOM VODOKHRANILISCHE.) Trudy VI Soveshchaniya po Problem. Biol. Vnutren. Vod 1959: 371-377; Referat. Zhur., Biol., 1961, No. 2D679. Biological Abstracts, Vol. 36, No. 23, Abst. No. 79101. 1961.

This reservoir can be divided into 3 parts; the upper stratum approximates the fluvial type; in the lower stratum, the fluvial pattern develops only for a short period during heavy spring floods. The profluence of the Dubossarsk reservoir is high. After the river was controlled, both zooplankton and benthos were significantly enriched; the number of diverse forms decreased somewhat, but the relative proportion of crustaceans increased. Rotifers predominate only in the upper portion. The average quantity of zooplankton throughout the basin, as compared with that of the river, increased 165 times, and the biomass increased 1000-5000 fold. The zooplankton has 2 maxima: a June maximum (accounted for by copepods), and the September maximum (due to cladocera). The qualitative makeup of the bottom fauna was reduced from 193 to 140 forms; it was dominated by pelorheophilic associations and was quantitatively enriched. In the benthos, the dominant forms were Ilyodrilus hammoniensis, Limnodrilus claparedeanus, L. hoffmeisteri, Cryptochironomus defectus, Tendipes thummi, T. f. l. semireductus, Polypedilum nubeculosum, Pelopia punctipennis, and Procladius. The process of benthos formation is still not fully completed. Despite the abundant bottom fauna, certain biologic niches are still empty, as is evidenced by the successful acclimatization of the mysid Limnomysis benedeni, which had been introduced into the Dubossarsk reservoir. The gradual tapering off of the development of the bottom fauna, which has been observed in the Rybinsk, Veselovsk, and other reservoirs, has not been noted in the majority of the reservoirs in southern rivers. (Auth.)

4788. Ozhegova, V. E. 1959. CONTRIBUTIONS TO THE HYDROBIOLOGIC CHARACTERIZATION OF THE FARKHAD RESERVOIR ON THE SYR-DAR'YA RIVER. (MATERIALY K GIDROBIOLOGICHESKOI KHARAKTERISTIKE FARKHADSKOGO VODOKHRANILISHCHA NA SYR-DAR'E.) Trudy VI Soveshchaniya po Problem. Biol. Vnutren. Vod 1959: 505-509; Referat. Zhur., Biol., 1961, No. 2D680; Biological Abstracts, Vol. 36, No. 23, Abst. No. 79102. 1961.

A characterization is given of the changes in the phyto- and zooplankton and benthos from 1947 to 1955. At present, the phytoplankton and zooplankton are qualitatively and quantatively poor The zooplankton (which is dominated mainly by predaceous copepods) is quantitatively poor, and is significantly affected by the passage of the summer floods. In the bottom fauna, tendipedid larvae predominate. In the benthos, limnophilic forms prevail, accumulating in calm places. There are 3

principal biocoenesis: (1) argillaceous ooze of fluvial sediments; (2) dark gray ooze of flood soils; and (3) overgrowths of aquatic plants. The more the Farkhad reservoir becomes silted (its development goes according to the pattern of river-reservoir-river), and the more its profluence increases, the more the biomass of benthos increases over the years. The ichthyofauna is represented by 26 species. The food areas of benthophagic fish have been reduced in the course of time, and the make-up of the food components has changed. Control of the river above the Farkhad reservoir and the creation of the Kara-Kum reservoir should have a favorable effect on the biologic pattern of the Farkhad reservoir and raise its productivity, since it is reducing silting and is levelling off the effect of flooding on the development of the zooplankton. (Auth.)

4789. Bandt, Hans Joachim. 1960. CHEMICAL DESTRUCTION OF INSECTS AND WEEDS POISONS WATER. Wasserwirt. Wassertech. 10: 30-33; Biological Abstracts, Vol. 36, No. 23, Abst. No. 79113. 1961.

The increased usage of org. poisons as insecticides and herbicides has increased the problems involved in accidental poisoning of fish. Various insecticides are discussed in terms of their use and toxicities to fish. (Courtesy Chem. Absts.)

4790. Ivanov, Lyudiya. 1960. A METHOD FOR RELATIVE EVALUATION OF THE CONDITION OF THE STOCK AND PREDICTION OF THE EXPECTED CATCH OF FISH HAVING A SHORT LIFE CYCLE. (METOD OTNOSITEL'NOI OTSENKI SOSTOYANIYA ZAPASA I PROGNOZIROVANIYA OZHIDAEMOGO ULOVA RYB S KOROTKIM ZHIZNENNYM TSIKLOM.) Voprosy Ikhtiol. 14: 160-165; Referat. Zhur., Biol., 1961, No. 6D244; Biological Abstracts, Vol. 36, No. 23, Abst. No. 79124. 1961.

In formulae based on a suggested biostatistical method for evaluating the condition of the stock and predicting the catch of fish with a short life cycle, the likely catch at a given state of organization of the industry is considered as a function of the relative number of fish carried over from the previous year and the number of new recruits. A decrease in number of recruits, hence of the stock as a whole, is accompanied by an increase in the average size of the fish in the stock and by a predominance of adult fish, while an increase in numbers is accompanied by a decrease both in size and in the average age of the population. This is explained by the fact that fluctuations in ratio of carry-over to recruitment are determined by the recruitment each year, which varies greatly. (Auth.)

4791. Kossov, E. G., M. S. Lazarev, and L. V. Polikashin. 1960. PINK SALMON, ONCORHYNCHUS GORBUSCHA, IN THE BASINS OF THE BARENTS AND WHITE SEAS. (GORBUSHA V BASSEINAKH BARENTSEVA I BELOGO MOREI.) Rybnoe Khoz. 8: 20-25; Referat. Zhur., Biol., 1961, No. 5D503; Biological Abstracts, Vol. 36, No. 23, Abst. No. 79127. 1961.

As the result of work in acclimatization, O. gorbuscha with a length of 46-52 cm and a weight of up to 1.5 kg appeared along the coast of the Kola Peninsula at the end of June, 1960. The preparation of the eggs for transport and their transport before incubation and hatching of the young in the Kola, Ura, Umba and Niva rivers are described. The appearance of adult salmon indicates the possibility of successful acclimatization of this fish. (Auth.)

4792. Kuderskii, L. A. 1960. THE IMPORTANCE FOR THE FISH INDUSTRY OF THE PIKE-PERCH IN NORTHERN LAKES. (O RYBOKHOZYAISTVENNOM ZNACHENII SUDAKA V SEVERNYKH OZERAKH.) Rybnoe Khoz. 5: 15-17; Referat. Zhur., Biol., 1961, No. 7D419; Biological Abstracts, Vol. 36, No. 23, Abst. No. 79128. 1961.

Propagation of pike-perch, Stizostedion lucioperca, is not always advantageous in northern lakes. In establishing pike-perch one must estimate what effect it will have on the stocks of other valuable species of fish. Thus, in lakes of the whitefish-cisco type, the pike-perch is an undesirable component in the fish fauna. In lakes of the bream-cisco type, rich in bottom fauna, the presence of the pike-perch is useful. The fishery should be organized so as to conserve young pike-perch and increase predation of large pike-perch on the less valuable fishes (ruffe, perch, roach) that compete for food with the valuable bream. (Auth.)

4793. Nikol'skii, G. V. 1960. TYPES OF ADAPTATION TO SELF-REGULATION OF POPULATION SIZE IN FISH. (O FORMAKH PRISPOSOBLENII K SAMOREGULYATSII CHISLENNOSTI POPULYATSII U RYB.) Zhur. Obshchei Biol. 21(4): 233-244; Referat. Zhur., Biol., 1961, No. 6D243; Biological Abstracts, Vol. 36, No. 23, Abst. No. 79139. 1961.

An increase in the productivity of populations of commercial fish or an increase in the catch can only be attained by the proper organization of the exploitation of the stock and by a decrease in the natural mortality of the population being fished. This is possible only on the basis of information on the dynamics of the population, i.e., the adaptive response of the population to a change in the external conditions, above all to changes in the food supply at various stages of development. In fish, as in other organisms, adaptive responses are developed during life which make possible a change in the size of the population in case of a change in the food supply. The author considers the following to be the most important adaptations to regulate the size of fish populations: (1) a change in the reproductive capacity via changes in either the growth rate and time of sexual maturity or in the fertility of individuals of a given size; (2) a different approach of males of the spawning grounds in connection with differences in the quality of sexual products from

fish of varying size and age; (3) a transition to feeding on their own young; (4) the preservation of a high quality of sexual products under unfavorable nutritional conditions; (5) a change in the amplitude of the variations in the characteristics and properties of the population. (Auth.)

4794. Travin, V. I. 1960. BIOLOGY OF REDFISHES AND THE OUTLOOK FOR THEIR FISHERY IN THE NORTH ATLANTIC. (BIOLOGIYA MORSKIKH OKUNEI I PERSPEKTIVY IKH PROMYSLA V MORYAKH SEVERNOI ATLANTIKI.) Trudy Soveshchaniya, Ikhtiol. Komissiya Akad. Nauk SSSR 10: 125-130; Referat. Zhur., Biol., 1961, No. 5D529; Biological Abstracts, Vol. 36, No. 23, Abst. No. 79156. 1961.

Four species of redfish are known in the North Atlantic: Sebastes marinus, S. mentella, S. viviparus and Helicolenus dactylopterus. Only the first 2 are commercially important. All are viviparous. Large fish produce up to 400,000 larvae between the end of April and the beginning of June in the layer of water above the pelagic regions of the southern part of the Norwegian Sea and the northern part of the Atlantic Ocean at a temperature of 6-7°C. Redfish grow very slowly, making a study of their migrations difficult. The expansion of their commercial fishing requires a more intensive exploitation of already known areas of accumulation, and the discovery of new fishing grounds. (Auth.)

4795. Alexander, R. McN. 1961. VISCOELASTIC PROPERTIES OF THE TUNICA EXTERNA OF THE SWIMBLADDER IN CYPRINIDAE. The Journal of Experimental Biology, Vol. 38, No. 4, pp. 747-757.

The tunica externa of the anterior sac of the swimbladder in Cyprinidae is highly extensible, but a large part of its compliance is associated with retardation times greater than one second. The compliance is only partly reversible.

The significance of these properties is discussed in relation to a possible highpass frequency filter for the Weberian apparatus. (Auth.)

4796. Holt, S. J. 1959. MULTILINGUAL VOCABULARY AND NOTATION FOR FISHERY DYNAMICS. Food and Agriculture Organization of the United Nations, 42 pp.

This vocabulary is an extension of the standard terminology and notation published by Holt, et al. It is not intended to be comprehensive but lists terms in various languages only for the quantities to which a standard symbol was recommended in that paper. The arrangement follows the recommendations of UNESCO (1954). Terms in languages using the Cyrillic alphabet are also transliterated into Latin form, using the system proposed by the Royal Society, London (1953).

4797. Henry, Kenneth A. 1961. RACIAL IDENTIFICATION OF FRASER RIVER SOCKEYE SALMON BY MEANS OF SCALES AND ITS APPLICATIONS TO SALMON MANAGEMENT. International Pacific Salmon Fisheries Commission, Bulletin XII, 97 pp.

A method of racial identification of Fraser River sockeye salmon is developed in this study based principally on the number of freshwater scale circuli. The utility of the scale identification method in estimating daily racial catches and hatchery production is discussed. Applications of the racial scale analysis method to many salmon management problems demonstrates its value in the management of the Fraser River sockeye salmon fishery and illustrates the principles upon which the management of the Fraser River sockeye salmon fishery is based as well as some of the practical problems that must be solved in a successful salmon management program. The numerous management problems discussed include the determination of route of saltwater migration, time of saltwater migration, speed of migration, delay, escapement, marine survival, production relationships and fishing mortalities. (Auth.)

4798. Pope, J. A., D. H. Mills, and W. M. Shearer. 1961. THE FECUNDITY OF ATLANTIC SALMON, SALMO SALAR LINN. Department of Agriculture and Fisheries for Scotland, Freshwater and Salmon Fisheries Research, No. 26, 12 pp.

Egg counts made on salmon from six Scottish rivers taken during 1957, 1958 and 1959 are analyzed.

The method of obtaining the counts is described and the counts are shown to increase with length according to a law of the form $N = cL^b$.

Comparisons of counts in different years and from different rivers show that, while the relationship between egg number and length is not subject to significant year-to-year variations, significant differences exist between rivers.

The use of the fecundity-length relationships derived is discussed and the sampling errors involved in their use given.

The relationship between egg size and length is investigated and it is shown that egg size increases with length and hence the fecundity.

A weight-length relationship is derived.

The general implications of the results obtained are briefly discussed. (Auth.)

4799. Westfall, Bertis A., Robert L. Russell, and Theodore K. Auyong. 1961. DEPRESSANT AGENT FROM WALNUT HULLS. Science, Vol. 134, No. 3490, p. 1617.

Crushed unripe walnut hulls, Juglans nigra, when extracted with ether, yield an extract which sedates or at least depresses the movements of Daphnia magna, leopard frogs, perch, catfish, goldfish, mice, rats, and rabbits. One purified depressant compound, 5-hydroxy-1,4-naphthoquinone (juglone), has been isolated and tested on most of these species. (Auth.)

4800. Hester, Frank J. 1961. A METHOD OF PREDICTING TUNA CATCH BY USING COASTAL

SEA-SURFACE TEMPERATURES. California Fish and Game, Vol. 47, No. 4, pp. 313-326.

Tuna landings from southern California waters fluctuate from year to year both in quantity and area of capture.

A correlation has been shown between sea-surface temperature (July, August, and September mean) at two southern California shore stations and bluefin and albacore catch from selected areas.

This correlation holds when winter water temperatures are used permitting a forecast of bluefin and albacore catch before the season begins.

Equations have been given for predicting any year's bluefin and albacore catch in selected areas and limits of confidence are set.

Landings from the selected areas have been compared with total California landings. (Auth.)

4801. Smith, Emil J., Jr. 1960. A MECHANICAL NET-PULLER FOR SKIFF FISHING WITH GILL NETS. California Fish and Game, Vol. 47, No. 4, pp. 327-333.

A mechanical net-puller or gurdy was developed by Dingell-Johnson Project F-16-R to assist in fishing with gill nets to obtain samples of project species. Fishing gill nets by hand had proved difficult and time consuming in deep water and required a two to four man crew. The net-puller enabled fishing with gill nets to a depth of 180 feet and it was felt they could have been fished deeper. By using the gurdy, one man could handle the nets. The gurdy was also found useful for pulling beach seines and lobster pots and with slight modification its efficiency for these purposes could be greatly increased. (Auth.)

4802. Warner, George H., Donald H. Fry, Jr., and A. Nelson Culver. 1961. HISTORY OF YEARLING KING SALMON MARKED AND RELEASED AT NIMBUS HATCHERY. California Fish and Game, Vol. 47, No. 4, pp. 343-355.

A total of 20,579 yearling king salmon from a late-running strain was marked and released at Nimbus Hatchery in the spring of 1957. About 50,000 eggs were used to produce these fish; this represents the egg production of about nine females, or, 22 fish of both sexes.

Based on marked fish recoveries in the portion of the ocean troll catch sampled by Department of Fish and Game personnel, it is calculated that 88 marked salmon from the Nimbus plant were taken by the troll fishery in 1958 and 1959. These fish had a value of approximately $300 to the fishermen.

There is evidence that marked fish from Nimbus were taken in the ocean sport fishery, but no sampling was done and no estimate could be made of numbers. Two marked fish were returned by sport fishermen; these represented a value of $34.

A total of 492 marked fish returned to the hatchery. Of these, 102 were two-year-old jacks, 336 were three-year-old fish, and 54 were four years of age. In addition, an estimated 24 marked fish died above the Number fish racks.

Marked females were nearly all green on arrival at the hatchery and had to be held an unusually long time before spawning. A mortality of 32 percent occurred during this period.

Most of the marked fish returned to the hatchery in late November and December, indicating that progeny from a late-running strain of salmon tended to retain the late-running characteristic.

A total of 1,020,300 eggs was taken from marked fish returning to Nimbus Hatchery. This represented a net gain of more than 900,000 eggs over the number of eggs required to produce the group of fish which was marked.

It is estimated that 216 marked salmon spawned in the American River. Of these, it is calculated that 33 were females which produced 188,100 eggs.

About 4 percent of marked yearling salmon released at Nimbus Hatchery can be accounted for in the ocean catch and in the spawning runs in the American River.

High temperatures at Nimbus Hatchery resulted in an abnormally high rearing cost for the fish used in this experiment. The Department expects to have a cooler water supply in the future.

Based on the 1958 average rearing cost of catchable and sub-catchable trout, the future cost of rearing a similar group of salmon would be about $1,830 as compared with the $300 value of the commercial catch from this group and the minimum sport catch value of $34.

The cost of producing a spawner (at 1958 rearing costs) would be about $2.50 per fish, or $4.03 if two-year-old spawners are excluded.

A healthy king salmon fishery often supports a catch-to-escapement-ratio at least as high as three or four to one; in this experiment the ratio was less than one-fourth to one.

The yearling salmon which returned to the hatchery were 2.39 percent of the total number released; an additional 1.17 percent spawned naturally; thus the total spawning escapment was 3.56 percent.

Nimbus Hatchery returns were compared with the hatchery returns of 65 other releases of marked king salmon. Thirty-one of these groups were of fall run fingerlings released in their first spring. Nine groups of fall run fish were released in their first fall. The average rates of return were 0.070 and 0.164 percent respectively. Seventeen groups were of spring run yearlings. The average rate of total spawning escapement was 0.95 percent and the maximum was about 3.6 percent. There were eight other groups of fish which did not fit any of the above classifications.

If future experiments show similar rates of return, the release of yearling kings might prove to be an effective way of building up a depleted run. (Auth.)

4803. Wales, J. H., and D. P. Borgeson. 1961. CASTLE LAKE INVESTIGATION--THIRD PHASE: RAINBOW TROUT. California Fish and Game, Vol. 47, No. 4, pp. 399-414.

The mean return to the angler of four plants of catchable-sized, fall-spawning, domestic rainbows was 79.9 percent.

The percentage returned to the angler of a plant of 2,500 rainbow trout, weighing 7.8 per pound, was slightly better than the return from and equal lot weighing 13.1 per pound. However, in terms of weight stocked, the smaller fish gave a substantially higher return.

In addition to their more efficient use of the lake's fish producing potential, plants of small-sized trout are more economical. The cost in the creel of catchable-sized rainbows ($0.19 each) is almost four times as much as the cost of fingerlings ($0.05 each) in Castle Lake.

The return to the angler from air plants was appreciably less than that achieved through truck planting in Castle Lake.

A plant of 3,833 untagged rainbows, 5.0 per pound, returned significantly better than 980 of the same lot tagged with an experimental subcutaneous tag.

Angling success during the rainbow trout phase was high, with the catch per angler hour averaging 1.0 trout. Fishing pressure dropped appreciably after 1957, due probably to deterioration of the Castle Lake road the the recent development of good trout fishing in nearby Dwinnell Reservoir.

Due to insufficient data, a decision regarding the best strain of rainbows for Castle Lake was not reached. However, in order to minimize variability during anticipated lake fertilization experiments, the temporary choice of a single strain was necessary The domestic fall-spawning strain was chosen because of its suitability to the lake and because more data have been obtained for it than for the other rainbows tested in Castle Lake. The single plant of Kamloops rainbows showed considerable promise. Further experiments with them appear warranted.

Under a species catch composition similar to 1958 and 1959, 10,000 rainbow fingerlings appear to be the proper number to stock in Castle Lake annually. This amounts to 210 fish per surface acre.

The annual yield during the rainbow trout phase was greater than that during the earlier phases. However, the actual gain in yield (pounds harvested minus pounds planted) during the rainbow phase over that of naturally-produced brook trout was only 1.4 pounds per acre.

The gross increase in yield (119 pounds per year or 2.5 pounds per acre per year) brought about by the stocking of rainbow fingerlings was found to cost $1.26 per pound.

This increase in yield was costly, since the heavy rainbow stocking established a rainbow population chiefly at the expense of, not in addition to, the naturally-produced brook trout population.

The steady decline of the brook trout population since 1954 is believed to be due primarily to competition brought about by heavy rainbow stocking and predation by large rainbows.

Most western lakes of the Castle Lake type are relatively inaccessible and are subject to very light fishing pressure. Under these conditions, self-sustaining brook trout populations generally provide excellent fishing. It must be concluded that, when spawning tributaries are absent, such waters can be more economically managed with wild brook trout alone than with hatchery supported brook-tainbow populations. (Auth.)

4804. Kurenkov, I. I. 1959. ON THE CAUSES OF THE MARKED DECLINE IN KAMCHATKA SALMON POPULATIONS. (O PRICHINAKH ZNACHITELNOVO SNIZHENIIA CHISLENNOSTI KAMCHATSKIKH LOSOSEI.) Priroda, No. 2, p. 123; Fisheries Research Board of Canada, Translation Series No. 262, 2 pp. 1960.

The causes of this decline are fully apparent - the effect of the intensive catching of salmon in the sea, carried on by the Japanese fishing fleets. The basis for this lies in the fact that a great many drift nets are operated right in the migration path of the salmon proceeding, for spawning, to the mouths of the rivers. Last year the total length of nets mounted to several thousand kilometres. As a result, a large part of the adult run did not reach the Kamchatka coast and that portion which did successfully get to the home streams was to such a degree damaged by the fine nylon thread of the nets that many perished without spawning.

The number of such damaged fish increases proportionately with the increase in intensity of sea fishing. Thus, for example, in 1954, only the occasional damaged fish was observed in the spawning runs but in 1958, they amounted to 15-20% of the whole population and in some rivers constituted even as much as 50%. Such a simultaneous catastrophic drop in the total abundance of spawning runs could not be attributed to the activity of the volcanoes in Kamchatka, even if they were all to have begun to erupt at one and the same time. (Auth.)

4805. Dvinin, P. A. 1949. LAKE COHO, ONCORHYNCHUS KISUTCH (WALBAUM) MORPHIA RELICTUS NOVA. (OZERNYI KIZHUCH ONCORHYNCHUS KISUTCH (WALBAUM) MORPHA RELICTUS NOVA.) Doklady Akademii Nauk SSSR, Vol. 69, No. 5, pp. 695-697; Fisheries Research Board of Canada, Translation Series No. 285, 3 pp. 1960.

The lake coho of Little Saran Lake are distinguished from anadromous coho by a somewhat larger number of scales on the lateral line and rakers on the first gill arch, and more particularly by a considerably smaller number of vertebrae and pyloric caeca, a shorter snout, a considerably larger eye, longer supramaxillary bone and narrower forehead. In addition the dorsal and anal fins are higher and their bases are longer. Finally, the pectoral and pelvic fins and also the upper lobe of the caudal fin are longer.

The lake coho become mature at the same age as anadromous, in the third or fourth year of life. The fecundity of the females varies from 1228 to 3066 eggs, average 1600, while in the anadromous coho of the Paratunka River, the minimum fecundity is 2800, the maximum is 7600 and the average is 4350. Spawning of the lake coho begins later than

among the anadromous ones, approximately the middle of October, and it ends the end of March. The spawning grounds are in the inshore zone of the lake in regions of gravelly bottom where there is an outflow of ground water at a depth of not above 1 m.

After spawning the lake coho die, as do the anadromous ones.

The lake coho in the first and second year of life grows more quickly than the anadromous coho does in the river up to the time of its migration to sea. However, after migration to the sea the anadromous coho in its first year of life overtakes the lake coho in growth and attains a considerable size.

Thus, at the time it achieves sexual maturity, the lake coho is only a little more than half as large as the anadromous one.

4806. Enîutina, R. 1954. MORPHOBIOLOGICAL AND MORPHOMETRIC CHARACTERISTICS OF THE PINK SALMON OF THE AMGUN AND ISKI RIVERS. (MORFOBIOLOGICHESKAÎA I MORFOMETRICHE - SKAÎA KHARAKTERISTIKA GORBUSHI REK AMGUNI I ISKI.) Izvestiîa Tikhookeanskiĭ N.-I. Institut Rybnovo Khozîaĭstva i Okeanografii, Vol. 41, pp. 333-336; Fisheries Research Board of Canada, Translation Series No. 289, 7 pp. 1960.

The pink salmon of the Iski River differ from the pinks of the Amgun River in morphobiological characters (size, weight, rate of growth, fecundity, state of the gonads, condition) and also in a number of morphometric characters.

The dissimilar rates of growth in the first year of life found in the forms of gorbusha studied is to be explained, apparently, by their frequenting different marine foraging grounds during their feeding period--grounds which differ in food supply and physical environmental conditions.

The character of the alternation of weak and strong generations differs as between the Amur and Iski pink salmon; the latter agrees with the periodicity of the migration of gorbusha to the whole coast of the Sea of Okhotsk.

The above is enough to indicate that the Iski River gorbusha do not belong to the Amur division of this species; in all probability they are a portion of the Okhotsk stock.

Our data confirm that rivers situated quite close to one another can be inhabited by different stocks of gorbusha. Consequently in planning fishing it is necessary to consider which particular stock pink salmon belong to, since each stock is distinctive in respect to fluctuations in the strength of its runs from year to year, and to a considerable degree is independent of the condition of the stocks. (Auth.)

4807. Birman, I. B. 1960. ON THE PERIOD OF FORMATION OF THE ANNUAL RINGS ON THE SCALES OF PACIFIC SALMON AND THE RATE OF GROWTH OF PINKS. (O SROKAKH FORMIROVANIIA GODOVYKH KOLETS NA CHESHUE TIKHOOKEANSKIKH LOSOSEI I TEMPE ROSTA GORBUSHI.) Doklady Akademii Nauk SSSR, Tom 132, No. 5: 1187-1190; Fisheries Research Board of Canada, Translation Series No. 327, 4 pp. 1960.

In connection with the growth of the scales it is necessary to note that not only the total number of sclerites but also the rate of their formation was considerably greater in the first year (more accurately, in the first summer) than in the second. In the second year the majority of the sclerites (in our examples, 10 out of 13) were laid down prior to the beginning of the spawning migration, during the wintering period. The width of these sclerites on the average was the same as in the first year. In general, in the zone of the first and second years the average width of the sclerites was approximately the same. But since in the summer of the first year they were laid down much more quickly it is apparent that in the second year, particularly in the summer, the increase in the size of the scale was much retarded. In the main, the rate of laying down the sclerites characterizes the rate of formation of the scales.

Such are the principal features of the growth of pinks.

In conclusion, some mention may be made of the spring picture of the scales of other salmon.

In the cohos, caught in the second half of April, there are already present in the growth of the second (last) ocean year up to 11-12 wide sclerites, as compared with 24-29 sclerites in the first year zone. The fish reached an average length of 47.4 cm. Consequently, for cohos the ocean annual ring was formed long before the onset of spring.

In the majority of sockeye, in fourth and fifth year, the scales carried the appropriate number of annual rings and, in addition, one or more sclerites of the last year's growth. But in some fish the annual ring had only just begun to show and in others it was not there at all.

Among the chums there were many fish, which had completed three or four years, which still did not have the last annual ring (similar individuals were also caught in early May); in others it was already present but without any indication of growth of the following year, and in three cases such growth had only just begun.

In general, in these two species of salmon, as distinct from the pinks and coho, the annual ring had actually been laid down in the spring: in the sockeye - chiefly, apparently, in March, but in the chums - in April. It is quite evident that in these cases it does not reflect the winter conditions of growth. (Auth.)

4808. Radakov, D. V. and B. S. Solovev. 1959. A FIRST ATTEMPT AT USING A SUBMARINE FOR OBSERVATIONS ON THE BEHAVIOR OF HERRING. (PERVYĬ OPYT PRIMENENIIA PODVODNOĬ LODKI DLIA NABLIUDENIĬ ZA POVEDENIEM SELDI.) Rybnoe Khozîaĭstvo, Vol. 35, No. 7, pp. 16-21; Fisheries Research Board of Canada, Translation Series No. 338, 6 pp. 1961.

The results of ichthyological research, during the first voyage of the submarine in the wintering area of the Atlantic herring, allowed us to confirm

and substantiate the views held on the passivity of wintering herring. During this voyage we also obtained quantitative data, which characterize the degree of mobility of the "spread-out" herring and their changes during the dark period of the day. Hence, it appears herring is caught in drift nets only during the periods of rising activity, connected with the morning and evening vertical migrations. The observation about the concentration of herring, obtained by sonic depth finder and simultaneous visual observation through the sidelight, allows us a quantitative estimate of the readings of search apparatus, and therefore show one of the possible ways of working out methods for evaluating the fishing prospects in individual herring concentrations. (Authors)

4809. Stauffer, Thomas M. 1961. DISTRIBUTION OF SEA LAMPREY AMMOCOETES IN LAKE MICHIGAN TRIBUTARIES OF THE UPPER PENINSULA OF MICHIGAN, 1955-1959. Michigan Department of Conservation, Misc. Pub. No. 14, 21 pp.

Twenty-five tributaries of northern Lake Michigan, between St. Ignace and Menominee, were surveyed with a direct-current shocker in 1955-1959 to determine the distribution and abundance of sea lamprey ammocoetes. Game-fish surveys of two of these streams and two other tributaries, in 1952-1958, provided supplementary information. Ammocoetes were found in 20 of the 27 streams examined. Stream systems judged to contain the largest population of larvae were (from west to east) the Cedar, Ford, Whitefish and Sturgeon rivers. Streams with moderate populations were the Bark, Days, Rapid, Ogontz, Fish Dam, Millecoquins and Black rivers. Streams which contained at least a small population of ammocoetes were (from west to east): Tacoosh River, Squaw Creek, Little Fish Dam and Manistique rivers, Bulldog Creek, Milakokia River, Hog Island Creek, Paquin Creek, and Brevoort River.

The collection data for the surveys of tributaries of northern Lake Michigan are summarized in Table 1.

4810. Hempel, Gotthilf, and Dietrich Sahrhage. 1961. ON CONCEPTS OF MODELS FOR THE DYNAMICS IN DEMERSAL FISH STOCKS. (NEUERE MODELLVORSTELLUNGEN ÜBER DIE DYNAMIK DER GRUNDFISCHBESTÄNDE.) Berichte der Deutschen Wissenschaftlichen Kommission für Meeresforschung, Band XVI, Heft 2, pp. 51-89.

The significance of mathematical models for the theory of fishing in marine fish stocks is discussed giving an outline on the historical development up to the model evolved by Beverton and Holt.

In the second part of this paper a review is provided on the structure of that model. Thereby a special description of the methods of calculation is resigned.

Possibilities and boundaries in the application of population dynamic models are discussed in a final critical consideration. (Authors)

4811. Aker, Erdal. 1961. INVESTIGATIONS ON THE BIOLOGY OF THE MACKEREL IN THE NORTH SEA. (UNTERSUCHUNGEN ÜBER DIE BIOLOGIE DER MAKRELE (SCOMBER SCOMBRUS L.) IN DER NORDSEE.) Berichte der Deutschen Wissenschaftlichen Kommission für Meeresforschung, Band XVI, Heft 2, pp. 105-128.

The formation of the scales of the mackerel takes place in their first year of life, and that in the first autumn at a length of about 8-9 cm. The use of scales for age determination is inappropriate owing to the difficulty of obtaining suitable scales, and the complications resulting from the regeneration of lost or damaged scales which makes it necessary to examine a large number for each fish. Determining the age by using the otoliths is preferable.

The mean length of the age groups for the early summer (spawning time) are as follows: I-group 20,1 cm, II-group 26,3 cm, III-group 33,8 cm, IV-group 35,0 cm. For the older age groups, the annual increments amount to less than 1 cm.

The maturity in both sexes is reached at the end of the third year of life, with a body-length of not less than 28 cm.

Generally, in the open sea the young mackerel of the 0-group were caught only in small quantities by the herring trawl. As the year-class 1954 (age group I/II in the course of 1956) was nearly totally absent in the catches, great fluctuations in the stock of mackerel in the North Sea are to be supposed.

The number of male fish predominates over that of the females (54,7 : 45,3% in the catches of "Anton Dohrn"). The sex ratio differs in connection with the size. Up to 30 cm. in length the males predominate by 58,3%, from 31 cm. however the females prevail by 53,4%.

The proportion of the weight of the ovaries to the weight of the fish is, in case of juvenile, spent, and recovering females, less than 2%; with ripening and spawning fish on the other hand it goes up to 20%.

The fecundity of the mackerel was determined for 21 females of maturity stages IV-V. Counting the eggs which are to be spawned in the following spawning time, is complicated by the fact that not all the eggs ripen at the same time, and always eggs of all sizes are to be found in the ovary. The number of eggs found ranges between 374,000 in an individual (31 cm in length) and 957,000 (35 cm). The fecundity was found to be proportional to the weight (in g) and the cube of the length (in cm) according to the formula: $F = 1919.G = 1549.L^3$. Considering the wide dispersion of the single values, a linear relation between the number of eggs and the length also can be regarded as a sufficient approximation, following the formula: $F = 51,500\ (L-22,1)$. The average number of eggs for a fish 250 g in weight (about 31,5 cm in length) is found to be 480,000, and for one of 400 g (37 cm) as 768,000.

The relation between the number of eggs and the weight of the ovaries is expressed by the formula: $F = 248,000 + 8640.G_{ov}$. For a fish with gonads weighing 20 g, the egg number is 420,000 in the

average, and for one with 65 g gonad it is 810,000, provided that the female is in the maturity stage IV-V.

The observed egg numbers vary considerably for the same length or weight, the relation between the lowest and the highest value may be nearly as 1 : 2. (Auth.)

4812. Judy, Mayo H. 1960. VALIDITY OF AGE DETERMINATION FROM SCALES OF MARKED AMERICAN SHAD. U. S. Fish and Wildlife Service, Bureau of Commercial Fisheries Bulletin 185, 9 pp. 1961.

In the fall of 1952, one hundred thousand juvenile American shad, marked by removal of the right pelvic fin, were released in the Connecticut River. Seventeen marked fish were recovered in the river in 1956, 70 in 1957 and 39 in 1958. Ages of the fish, determined from their scales, were 4, 5, and 6 years, respectively. These findings were in agreement with known age established from markings and therefore validate annuli and spawning marks as criteria for age determination of shad. (Auth.)

4813. Farris, David A. 1959. ABUNDANCE AND DISTRIBUTION OF EGGS AND LARVAE AND SURVIVAL OF LARVAE OF JACK MACKEREL, TRACHURUS SYMMETRICUS. U. S. Fish and Wildlife Service, Bureau of Commercial Fisheries Bulletin 187, 32 pp. 1961.

Distribution and abundance of eggs and larvae of the jack mackerel, Trachurus symmetricus (Ayres), and survival of the larvae are described, utilizing quantitative data collected on monthly cruises of the California Cooperative Oceanic Fisheries Investigations during 1951-54.

Spawning in the period 1951-1954 occurred from Washington to Magdalena Bay, Baja California. In each of the 4 years it began in February and ceased by October. The peak month of spawning was March in 1951 and May in 1952, 1953, and 1954. About 30 percent of the spawning occurred during the peak month. Estimates of egg abundance varied by less than a factor of 2 during the 4 years studied.

The effect of temperature on the rate of development of eggs was investigated. Regression statistics are given for the developmental rate. Reliability of the regression was checked by direct observation of developing eggs at controlled temperatures.

The annual estimates of survival for 1952, 1953, and 1954 indicate a reasonably constant survival of month-old jack mackerel larvae in these years.

The growth rate of jack mackerel larvae was approximated from data derived by direct observation of developing jack mackerel larvae under laboratory conditions and was described by two successive logarithmic growth curves. The second curve originates at yolk sac absorption and has the lesser slope.

Survival data may be broken into two periods: the first period, concurrent with the fast growth period, is characterized by poor survival and may be the critical period; in the second survival is much better and growth much slower. (Auth.)

4814. Sindermann, Carl J. 1960. SEROLOGICAL STUDIES OF ATLANTIC REDFISH. U. S. Fish and Wildlife Service, Bureau of Commerical Fisheries Bulletin 191, 4 pp. 1961.

Individual variations in erythrocyte antigens have been found in redfish, Sebastes marinus, from the western North Atlantic. Two closely related antigens, tentatively labeled A_1 and A_2, were demonstrated with specific reagents created by absorptions of rabbit antisera. Each reagent would agglutinate cells of only one antigenic type, so it was possible to identify fish as possessing A_1 or A_2 antigen. Individuals with the erythrocyte antigen A_1 make up more than 75 percent of the Eastport (Maine) redfish population. Since antigen frequencies may vary from one population to another, quantitative studies of each major fishing area should provide further information about discreteness of groups and the extent of their movements. (Auth.)

4815. Bridges, W. R. and Austin K. Andrews. 1961. EFFECTS OF DDT SPRAY ON FISH AND AQUATIC INSECTS IN GALLATIN RIVER DRAINAGE IN MONTANA. U. S. Fish and Wildlife Service Special Scientific Report--Fisheries No. 391, pp. 1-4.

The Swan Creek drainage was treated with DDT at the rate of 1.0 pound per acre as a part of a larger spruce budworm control program. Although the plane didn't spray within one-quarter mile of the stream, a level of 0.01 ppm of DDT was measured in the water samples taken half an hour after the spraying. Tremendous numbers of aquatic insects were killed or seriously affected. Samples of these insects contained progressively larger amounts of DDT, up to 11.0 ppm after 3 hours. Rainbow trout exposed in the stream for various periods up to 96 hours suffered no apparent acute effects, but contained as much as 0.1 ppm of DDT in their tissues. (Auth.)

4816. Frey, Paul J. 1961. EFFECTS OF DDT SPRAY ON STREAM BOTTOM ORGANISMS IN TWO MOUNTAIN STREAMS IN GEORGIA. U.S. Fish and Wildlife Service Special Scientific Report--Fisheries No. 392, pp. 1-11.

DDT was sprayed at 0.5 pound per acre for elm spanworm control in two drainages in north Georgia in both 1959 and 1960. In one drainage, precautions were taken to avoid the stream, and no significant mortality to aquatic organisms resulted. In the other drainage, DDT reached the stream in a normal spray operation, and serious depletion of aquatic invertebrates resulted. Recovery of bottom organisms was rapid, and total numbers of inverte- were up to pre-treatment levels after four months. (Auth.)

4817. Graham, Joseph J., and William L. Craig. 1961. OCEANOGRAPHIC OBSERVATIONS MADE DURING A COOPERATIVE SURVEY OF ALBACORE

THUNNUS GERMO OFF THE NORTH AMERICAN WEST COAST IN 1959. U. S. Fish and Wildlife Service Special Scientific Report--Fisheries No. 386, 31 pp.

This report lists the physical, chemical, and biological data collected by scientists aboard the Hugh M. Smith of the Bureau of Commercial Fisheries and N. B. Scofield of the California Department of Fish and Game during the spring and early summer of 1959 off the coast of California and Baja California, Mexico. The purposes of the cruises was to locate the route of the spring migration of albacore into west coast waters and the subsequent early concentrations of these fish. (Authors)

4818. Jensen, Alvin L. 1961. METHODS FOR LIPID ANALYSIS. U. S. Fish and Wildlife Service Special Scientific Report--Fisheries No. 376, 76 pp.

4819. Rabanal, H. R. 1960. EFFECT OF NO FERTILIZATION AND NON-NITROGENEOUS FERTILIZATION UPON THE CHEMISTRY OF WATER, THE PLANKTON, BOTTOM ORGANISM AND FISH PRODUCTION IN PONDS THAT HAD RECEIVED COMPLETE (N-P-K) FERTILIZERS FOR THE PRECEDING 15-YEAR PERIOD. Dissert. Abstr., 21, 283-284; J. Sci. Fd Agric., Abstr., 1961, 12, i-208; Water Pollution Abstracts, Vol. 34, No. 10, Abst. No. 1806. 1961.

The effect of fertilization with nitrogenous and non-nitrogenous fertilizers on the productivity of ponds which had received complete fertilization for 15 years was investigated, and the results were compared with unfertilized ponds. Fertilization increased the yields of carp and goldfish, the yield being greatest in ponds treated with nitrogen, phosphorus and potassium. During the period of the experiments the concentration of total and organic nitrogen remained constant in the unfertilized ponds and increased in the fertilized ponds; the concentration of ammonia decreased in all the ponds and the concentration of nitrate increased slightly. (Auth.)

4820. Wrobel, S. 1959. INFLUENCE OF FERTILIZATION WITH NITROGEN AND PHOSPHORUS ON THE CHEMICAL COMPOSITION OF THE WATER IN FISHPONDS. Acta Hydrobiol., 1, 55-86; Water Pollution Abstracts, Vol. 34, No. 10, Abst. No. 1807. 1961.

Detailed results are given of the effects on the composition of the water in experimental fishponds of addition of superphosphate and ammonium sulphate. General conclusions from the results are that addition of ammonium sulphate did not produce a permanent increase in ammonia nitrogen, that the amount of nitrogen added (30 kg per ha) was too small to increase the mineral nitrogen or intensify photosynthesis, that addition of ammonium sulphate reduced the pH value and alkalinity of the water so that lime was required, that by using nitrogen and phosphorus the amount of phosphorus required could be reduced, that with phosphorus fertilizers at least two applications (middle of May and middle of July) were necessary, and that pH value, dissolved oxygen, oxygen demand, colour, and clarity of the water could be used as evidence of the action of the fertilizers.

4821. Fry, F. E. J. 1959. THE OXYGEN REQUIREMENTS OF FISH. Trans. 2nd Seminar biol. Problems Wat. Pollut.; Robt. A. Taft Sanit. Engng. Centre, Tech. Rep. W60-3, 106-109; Water Pollution Abstracts, Vol. 34, No. 10, Abst. No. 1809. 1961.

The author discusses and reviews work on the three levels of oxygen requirement which can be recognized for aerobic organisms such as fish, namely the minimum level for existence (the incipient lethal level), the minimum level for a specified degree of activity, and the minimum level required to maintain a population in a given locality (also called the oxykinetic level). It is concluded that the best single standard for the oxygen requirement of fish would be some measure similar to the half-scope level, that is the level required for activity equal to half that in water saturated with air.

4822. Nothlich, K. 1960. THE WATER EXAMINATION ROOM IN THE LEINE DAM AT HERRENHAUSEN. Dtsch. Gewasserkundl. Mitt., 4, 72-74; Water Pollution Abstracts, Vol. 34, No. 10, Abst. No. 1812. 1961.

A brief illustrated description is given of the water examination room built into the central pier of the Herrenhausen dam on the Leine. Water can be drawn from two levels and recording apparatus is installed for measurements of temperature, pH value, conductivity, and content of oxygen.

4823. Pearson, E. A. 1959. WHAT DOES THE SANITARY ENGINEER EXPECT OF THE BIOLOGIST IN THE SOLUTION OF WATER POLLUTION PROBLEMS? Trans. 2nd Seminar biol. Problems Wat. Pollut.; Robt. A. Taft Sanit. Engng. Centre, Tech. Rep. W60-3, 139-144; Water Pollution Abstracts, Vol. 34, No. 10, Abst. No. 1902. 1961.

The author discusses the biological aspects of water surveys in connection with the design of works to eliminate or minimize the effects of waste discharges on the aquatic environment, with special reference to the need for quantitative or statistically-valid data on the biota of the water and the sediments, and the effect which various concentrations of the waste would have on the significant organisms. It is considered that minimum specifications for biological measurements are needed, similar to those established for physical and chemical tests; and a programme is outlined for assessing the significant physical, chemical, and biological characteristics of waters and sediments.

4824. Doudoroff, P. 1959. HOW SHOULD WE DETERMINE DISSOLVED OXYGEN CRITERIA FOR FRESHWATER FISHES? Trans. 2nd Seminar Biol.

Problems Wat. Pollut.; Robt. A. Taft Sanit. Engng. Centre, Tech. Rep. W60-3, 248-250; Water Pollution Abstracts, Vol. 34, No. 10, Abst. No. 1909. 1961

The standards adopted by various regulatory agencies for controlling dissolved oxygen concentrations vary widely, largely owing to differences of opinion on the objectives to be achieved. These differences of opinion and the factors to be considered in establishing standards for dissolved oxygen concentrations are discussed, recognizing that the determination of water quality standards is an administrative, and not purely a scientific problems.

4825. Graham, R. J. 1951. EFFECTS OF FOREST INSECT SPRAYING ON TROUT AND AQUATIC INSECTS IN SOME MONTANA STREAMS. Trans. 2nd Seminar Biol. Problems Wat. Pollut.; Robt. A. Taft Sanit. Engng. Centre, Tech. Rep. W60-3, 62-65; Water Pollution Abstracts, Vol. 34, No. 10, Abst. No. 1927. 1961.

A report is given of a cooperative study made by the U. S. Forest Service and the Montana Fish and Game Department to determine the effects on bottom organisms and fish populations of spraying streams with DDT in the control of spruce budworm. In 7 streams sprayed in July 1956, the population of bottom organisms was substantially reduced, but considerable recovery occurred in 6 of the streams by the end of the summer; the fish population appeared to be unaffected in 5 of the streams, but 70- and 80- percent reductions occurred in the other 2 streams, respectively. In 1957, a more detailed chemical and biological study was carried out in a section of the Ruby River sprayed with DDT in a dose of 1 lb. per acre; effects on the bottom organisms were similar to those observed in the 1956 studies; dead suckers (the most abundant fish) were found for about 8 miles below the sprayed area, and the mortality of trout and whitefish in the subsequent spawning season was higher than usual; DDT was not found in the bottom sediments but was found on aquatic vegetation as late as September and for at least 10 miles below the sprayed area. Fish mortalities were also observed in a small mountain lake and in Big Hole River after spraying with DDT in 1957. Laboratory studies have indicated that the age of the fish affects their susceptibility to DDT; 3- to 5-inch trout fingerling were the most tolerant while larger fish and fish less than 1.5 inches long showed high mortality rates with concentrations of DDT as low as 0.02 p.p.m. Slight environmental changes, such as an increase in the temperature of the water of 3°, caused an immediate increase in the mortality rate, and the physiological changes due to spawning also rendered the fish more susceptible to DDT.

4826. Webb, F. E. 1959. AERIAL FOREST SPRAYING IN CANADA IN RELATION TO EFFECTS ON AQUATIC LIFE. Trans. 2nd Seminar Biol. Problems Wat. Pollut.; Robt. A. Taft Sanit. Engng. Centre, Tech. Rep. W60-3, 66-70; Water Pollution Abstracts, Vol. 34, No. 10, Abst. No. 1928. 1961.

The author explains the special problems of forest insect control in Canada, including the damage to salmon fisheries caused by DDT, even with the reduced dose of ½ lb. per acre which has been used since 1953 to control the spruce budworm. Drastic reductions in immature salmon have occurred in sprayed streams in both New Brunswick and British Columbia, and it is feared these reductions will be reflected in serious reductions in the number of adults when these generations return from the sea. Work is also summarized on the effects of DDT on fish food organisms (see Wat. Pollut. Abstr., 1960, 33, Abstr. No. 1293) and on the relative efficiency of possible alternative insecticides. DDD, Sevin (a carbamate), and Korlan (an organic phosphate) were all less toxic to salmon than was DDT, but the volume required to control spruce budworm would be prohibitive. Further tests are planned using Malathion. Studies using smaller doses of DDT showed that acceptable control of spruce budworm could be attained with 1/4 lb. DDT in 1 gal. of oil solvent per acre, with no observable effects on salmon smolts and only a slight reduction in the numbers of aquatic insects.

4827. Kerswill, C. J., P. J. Elson, M. H. A. Keenleyside, and J. B. Sprague. 1959. EFFECTS ON YOUNG SALMON OF FOREST SPRAYING WITH DDT. Trans. 2nd Seminar biol. Problems Wat. Pollut.; Robt. A. Taft sanit. Engng. Centre, Tech. Rep. W60-3, 71; Water Pollution Abstracts, Vol. 34, No. 10, Abst. No. 1929. 1961.

Studies on the effects of DDT spraying on the salmon population in the Miramichi river (see Wat. Pollut. Abstr., 1956, 29, Abstr. No. 1748) have been continued, and results are given diagrammatically for each year from 1950-1957, showing the populations of fry, small parr, and large parr, and discussed in relation to the times of spraying. There were indications of changes in the rate of growth in the years following spraying and these changes are being investigated.

4828. Cope, O. B. 1959. THE RETENTION OF DDT BY TROUT AND WHITEFISH. Trans. 2nd Seminar biol. Problems Wat. Pollut.; Robt. A. Taft sanit. Engng. Centre, Tech. Rep. W60-3, 72-75; Water Pollution Abstracts, Vol. 34, No. 10, Abst. No. 1930. 1961.

Fish, including trout and whitefish, taken from streams in Montana and Wyoming in areas which had been sprayed with DDT to control spruce budworm, were examined to determine the storage of DDT in the tissues. DDT was found in all the fish, at all seasons up to 11 months after spraying (when sampling ceased), and up to 85 miles downstream from the sprayed area; the greatest amounts were found in the visceral tract, followed by the pyloric caecum and brain, with no trace in the liver. Most of the fish also contained the metabolite DDE. More DDT and DDE were found in whitefish than in trout. The validity of the chemical method used to determine DDT was verified by comparative tests using the fly larva bio-assay method. Both methods

indicated the presence of DDT in the tissues of control fish from an untreated stream, a fish hatchery and a fish market. The implications of these results are discussed.

4829. Henderson, C., Q. H. Pickering, and C. M. Tarzwell. 1959. THE TOXICITY OF ORGANIC PHOSPHORUS AND CHLORINATED HYDROCARBON INSECTICIDES TO FISH. Trans. 2nd Seminar biol. Problems Wat. Pollut.; Robt. A. Taft sanit. Engng. Centre, Tech. Rep. W60-3, 76-88; Water Pollution Abstracts, Vol. 34, No. 10, Abst. No. 1931. 1961.

Laboratory bio-assay tests are reported on the toxicity to fish of organic phosphorus insecticides (see Wat. Pollut. Abstr., 1960, 33, Abstr. No. 1296), chlorinated hydrocarbon insecticides (see Wat. Pollut. Abstr., 1961, 34, Abstr. No. 362), and some newer insecticides, including the organic phosphorus compounds Guthion, Disyston, and Co-ral, and the carbamate Sevin. Data obtained with these newer insecticides are tabulated, showing the 24-, 48-, and 96-hour TL_m values for different species of fish and different dilution waters. Guthion appeared to be more toxic in soft water than in hard, and Disyston and Sevin more toxic in hard water; Co-ral was not toxic to the test fish (fathead minnows) in either type of water at concentrations up to its maximum solubility. The toxicity of organic phosphorus compounds varied greatly with the species of fish. Sevin showed a low degree of toxicity to fish, having a 96-hour TL_m value of 5.5-13 p.p.m., depending on the species of fish and the hardness of the water. No correlations could be established between the toxicity of these new insecticides to insects, fish, and mammals. Proposals are outlined for further studies, including the need for developing selective insecticides which are relatively non-toxic to fish, or of antagonistic additives which will reduce the toxicity to fish, with little effect on insecticidal activity.

4830. Byrd, I. B. 1959. WHAT ARE THE SIDE EFFECTS OF THE IMPORTED FIRE ANT CONTROL PROGRAMME? Trans. 2nd Seminar biol. Problems Wat. Pollut.; Robt. A. Taft sanit. Engng. Centre, Tech. Rep. W60-3, 46-50; Water Pollution Abstracts, Vol. 34, No. 10, Abst. No. 1933. 1961.

The author quotes reports from Georgia, Florida, Alabama, Louisiana, and Texas, showing that heptachlor and dieldrin, when used in the recommended dose of 2 lb. per acre to control the imported fire ant, cause serious destruction of fish and other wildlife.

4831. Bond, C. E., R. H. Lewis, and J. L. Fryer. 1959. TOXICITY OF VARIOUS HERBICIDAL MATERIALS TO FISHES. Trans. 2nd Seminar biol. Problems Wat. Pollut.; Robt. A. Taft sanit. Engng. Centre, Tech. Rep. W60-3, 96-101; Water Pollution Abstracts, Vol. 34, No. 10, Abst. No. 1934. 1961.

Studies were carried out at Oregon State College on the toxicity of various herbicides and potential herbicides to game fish, including fingerling of coho and chinook salmon, rainbow trout and large-mouth bass. Tests were carried out in both standing and flowing water, and with some of the compounds the effects of aeration and storage were studied. Results are tabulated in terms of the median tolerance limits and discussed individually for 15 different compounds.

4832. Walker, C. R. 1959. HERBICIDES. Trans. 2nd Seminar biol. Problems Wat. Pollut.; Robt. A. Taft sanit. Engng. Centre, Tech. Rep. W60-3, 272; Water Pollution Abstracts, Vol. 34, No. 10, Abst. No. 1935. 1961.

In this discussion on the control of aquatic weeds, consideration was given to the harmful effects of such weeds; the need for testing agricultural herbicides to determine their effectiveness on aquatic plants and evaluate both the acute and chronic toxicity to fish and fish food organisms (including reference to a method developed and used in Missouri, involving the use of a plastic weed control enclosure); factors affecting the distribution and effects of the herbicides, including the effect of carriers, solvents, and wetting agents included in the herbicide composition; known data on the toxicity of various herbicides, including the variation in results between different geographical localities, as regards both phytotoxicity and toxicity to fish; and the advantages, for use in the control of aquatic weeds, of herbicides combined with attaclay or volclay to form granules or pellets.

4833. Baxter, G. 1961. RIVER UTILIZATION AND THE PRESERVATION OF MIGRATORY FISH LIFE. Proc. Instn civ. Engrs, 18, 225-243; Water Pollution Abstracts, Vol. 34, No. 10, Abst. No. 1940. 1961.

The author outlines the life history of migratory fish and discusses the flow conditions which are necessary to ensure the preservation of such fish in rivers and streams affected by abstraction, diversion, or impounding schemes for water supply or hydro-electric purposes. The flow records of 15 rivers are analyzed and discussed, to establish the minimum flow requirements of the fish and to correlate these in incidence and duration with the conditions of natural flow. It is concluded that the traditional fixed rate of discharge of compensation water based quantitatively on yield and unrelated to biological need is unsuitable for fish life and should be replaced by a variable compensation flow regime based on the seasonal needs of the fish and of the river and incorporating provision for the release of freshets.

4834. Foster, R. F. 1959. THE SIGNIFICANCE OF THE UPTAKE OF RADIO-ISOTOPES BY FRESHWATER FISHES. Trans. 2nd Seminar biol. Problems Wat. Pollut.; Robt. A. Taft sanit. Engng. Centre, Tech. Rep. W60-3, 15-20; Water Pollution Abstracts, Vol. 34, No. 10, Abst. No. 1942. 1961.

The author discusses the determination of

radio-active contaminants in fish and the assessment of permissible limits, based either on the use of fish as food or on radiation damage to the fish themselves, according to the circumstances and the particular isotope to be considered.

4835. Ophel, I. L. 1959. INVESTIGATION OF THE EFFECTS OF RADIOACTIVE MATERIAL ON AQUATIC LIFE IN CANADA. Trans. 2nd Seminar biol. Problems Wat. Pollut.; Robt. A. Taft sanit. Engng. Centre, Tech. Rep. W60-3, 21; Water Pollution Abstracts, Vol. 34, No. 10, Abst. No. 1943. 1961.

Studies including the examination of water, mud, plants, and fish, are being carried out by Atomic Energy of Canada Ltd. to determine the effects of radioactive waste waters discharged to surface waters. The Ottawa river, to which radioactive waste waters are discharged (see Wat. Pollut. Abstr., 1961, 34, Abstr. No. 531) provides great dilution, and although some reconcentration by plants and animals occurs, the only radioactive isotope found in easily-detectable amounts in the aquatic animals is phosphorus-32. Radioactive isotopes deposited on the bottom of the river with the sediment are subsequently dissolved and carried away; after operation of the nuclear plant for 13 years, fission products are found on the river bottom near the plant only in millicurie amounts per square mile, and smaller amounts are found downstream. In Perch lake (see Wat. Pollut. Abstr., 1961, 34, Abstr. No. 531), much of the radioactive strontium is retained, largely in the bones of fish and other animals; after 3 years, only 30 percent of the strontium-90 entering the lake has left it and the concentration of this isotope in the bones of fish and aquatic mammals has reached more than a thousand times that found in the lake water. Experiments are in progress on the uptake of long-lived fission products by fish, and have shown that the uptake of strontium-90 is greatly reduced by the presence of calcium or magnesium in the water, and by low temperatures; the uptake is not dependent on ingestion of food since high concentrations of strontium-90 can be accumulated by direct absorption through the gills.

4836. Chipman, W. A. 1959. ACCUMULATION OF RADIOACTIVE POLLUTANTS BY MARINE ORGANISMS AND ITS RELATION TO FISHERIES. Trans. 2nd Seminar biol. Problems Wat. Pollut.; Robt. A. Taft sanit. Engng. Centre, Tech. Rep. W60-3, 8-14; Water Pollution Abstracts, Vol. 34, No. 10, Abst. No. 1945. 1961.

Studies are being carried out by the U. S. Bureau of Commercial Fisheries at Beaufort, N. C., to determine the possible damage to fish and shellfish resources by radioactive contamination. The author discusses various aspects of these studies, including factors affecting the biological accumulation and concentration of radionuclides and factors determining the hazard to man and the ability of the nuclides to cause radiation damage.

4837. Wilson, J. 1959. THE EFFECTS OF EROSION, SILT, AND OTHER INERT MATERIALS ON AQUATIC LIFE. Trans. 2nd Seminar biol. Problems Wat. Pollut.; Robt. A. Taft sanit. Engng. Centre, Tech. Rep. W60-3, 269-271; Water Pollution Abstracts, Vol. 34, No. 10, Abst. No. 1948. 1961.

In this discussion and review of work on the adverse effects of silt and turbidity on aquatic life, individual consideration was given to the reduction of light penetration and photosynthetic activity; smothering of bottom-dwelling animals and plants; impairment of fish spawning; reduction of waste-assimilation capacities; and effects on shellfish, particularly oysters, in estuaries. At present there is insufficient information to permit establishment of general criteria for the permissible levels of turbidity and settleable inert material in waters; and each case must be considered individually. Reference was made to a symposium on siltation held in Portland, Oregon, March 1959.

4838. Efford, I. E. 1960. A METHOD OF STUDYING THE VERTICAL DISTRIBUTION OF THE BOTTOM FAUNA IN SHALLOW WATERS. Hydrobiologia, 16, 288-292; Water Pollution Abstracts, Vol. 34, No. 11, Abst. No. 2013. 1961.

An illustrated description is given of a bottom sampler over which a freezing jacket can be lowered, permitting freezing of the sample (with liquid oxygen) to fix the animals in position in their respective layers, before removal. Typical results are included. Most species are still identifiable after freezing. In its present form, the sampler is only suitable for shallow streams, and cannot be used where there are many stones or the stones are greater than 1-2 cm. in diameter.

4839. Conover, R. J. 1961. A STUDY OF CHARLESTOWN AND GREEN HILL PONDS, RHODE ISLAND. Ecology, 42, 119-140; Water Pollution Abstracts, Vol. 34, No. 11, Abst. No. 2028. 1961.

A survey was carried out from August, 1955, to February, 1958, of Charlestown and Green Hill ponds, two shallow brackish ponds on the south shore of Rhode Island. It was found that phosphate, which is derived mainly from exchange with offshore water, was the factor limiting production over most of the pond system, but in the western basin of Charlestown pond, which receives almost no land run-off, nitrate may be the limiting nutrient. The water, especially the bottom water, was usually super-saturated with oxygen, probably as a result of high rates of photosynthesis by the dense growth of attached spermatophytes and associated algae. Two possible methods for improving conditions and productivity in the pond system are suggested.

4840. Arnal, R. E. 1961. LIMNOLOGY, SEDIMENTATION, AND MICRO-ORGANISMS OF THE SALTON SEA, CALIFORNIA. Bull. geol. Soc. Amer., 72, 427-478; Water Pollution Abstracts,

Vol. 34, No. 11, Abst. No. 2029. 1961.

Detailed results are given of a survey of the Salton sea in the Colorado Desert of California. This was originally a freshwater lake formed by a flood of the Colorado river in 1905, but by 1929 the water of the lake had become almost as saline as sea water because of intense evaporation and solution of salts present on the floor of the basin before the flood. In recent years, in spite of the high rate of evaporation, excessive run-off from irrigation water has maintained and even raised the level of the lake. Evaluation of the water budget has made it possible to anticipate future changes in the chemical composition of the water, and it is predicted that there will be an increase in the amount of sulphates in the water. Most of the sediments in the lake appear to be derived from the suspended solids transported by the Colorado river but some are of local origin. Foraminifera are the most abundant micro-organisms in the lake; variation in the pH value of the sediments appears to be the most important factor affecting their distribution. In contract to conditions in the ocean, the number of species decreases offshore, but as in the ocean the numbers of living foraminifera increase greatly after a bloom of phytoplankton. The average productivity of the lake is greater than that of the ocean.

4841. Schmassmann, W. 1959. DAMAGE TO FISH BY INDUSTRIAL WASTE WATERS. Reprint from Beseitigung und Reinigung industrieller Abwasser, R. Oldenbourg, München, 60-71; Water Pollution Abstracts, Vol. 34, No. 11, Abst. No. 2155. 1961.

After a description of some occurrences of accidental discharge of nicotine, cyanide, and benzole to streams and their effects, the author discusses the damage caused to fisheries by various types of polluting substances not directly poisonous. A survey of the number and types of cases of damage to fisheries in Switzerland over some years shows the importance of agricultural as well as industrial wastes. With increasing use of surface water for supply the economic importance of control of pollution is greater than that of the fisheries alone.

4842. Cohen, J. M., G. A. Rourke, and R. L. Woodward. 1961. EFFECT OF FISH POISONS ON WATER SUPPLIES. J. Amer. Wat. Wks Ass., 53, 49-62; Water Pollution Abstracts, Vol. 34, No. 11, Abst. No. 2156. 1961.

In continuation of studies on the effect of fish poisons on water supplies (see Wat. Pollut. Abstr., 1961, 34, Abstr. No. 1545), experiments were carried out on the threshold odour concentration of various fish poison formulations and on the efficiency of water-treatment processes in removing these odours. It was found that odours could be removed from water by treatment with activated carbon. Although the doses of carbon required are rather high it is pointed out that such treatment would be required only infrequently and would not therefore add much to the cost of water treatment; sustained treatment with carbon would be required however if formulations containing toxaphene are used, as toxaphene is very stable. Except for formulations containing toxaphene, much of the odour is due to the solvents used, and it is recommended that a more suitable solvent should be developed which will produce little or no odour when suspended or dissolved in water in a concentration of 2 mg per litre, will be non-toxic to humans and other mammals, will be of known composition, and will be readily dissipated by natural and biological agencies after dispersion in water. It has been observed that fish killed by rotenone do not all come to the surface immediately, and some experiments were therefore carried out on the removal of odours caused by decomposing fish. It was found that such odours can also be removed by treatment with activated carbon or by free residual chlorination.

4843. Trembley, F. J. 1960. RESEARCH PROJECT ON EFFECTS OF CONDENSER DISCHARGE WATER ON AQUATIC LIFE, PROGRESS REPORT, 1956 TO 1959. Institute of Research, Lehigh University, 154 pp.; Water Pollution Abstracts, Vol. 34, No. 11, Abst. No. 2157. 1961.

This report contains further information, including graphical and tabulated data, obtained in a 4-year investigation of the Delaware river near Martin's Creek, Pa., above and below a steam electricity generating station (see Wat. Pollut. Abstr., 1961, 34, Abstr. No. 1529). Since the river is free from pollution in this area, the results indicate the effects of temperature alone. It was concluded that the discharge of heated water to the river had little influence on the chemical characteristics of the water, except for a small but definite decrease in the concentration of dissolved oxygen, which was insufficient to cause fish mortalities. The heated water also caused considerable alterations in the periphyton population, which is representative of the greater portion of the micro-organisms; in particular, the blue-green algae and certain diatoms of the family Fragillariaceae became more abundant, while green algae and many species of protozoa became less abundant or were suppressed. There were, however, marked irregularities in the behavior of the periphyton population, not related to temperature, but probably attributable to chlorination of the condenser water; work still in progress indicates that the total annual production of micro-organisms in the heated zone would be considerably increased if chlorination were discontinued. The macro-invertebrate population was reduced in the heated water during the warm seasons, although most bottom-dwelling organisms survived owing to stratification. The number of rooted aquatic plants was also reduced, although 3 species appeared to have become acclimatized to the warm water. Studies on fish suggested that the LD_{50} value for temperature for fish in the Delaware river is higher than that previously reported from tests elsewhere. With the exception of shad, all species of fish

normally inhabiting the unheated Delaware river were also found in the heated zone at some time during the year. While there was almost complete elimination of most species from the most heated zone during the warm months, a congregation and extended period of feeding activity of many species occurred in the heated zones during the cold months when there is little fishing in other parts of the river. Anadromous fish migrated successfully through the heated water zone, and successful spawning was also observed in this zone.

4844. Dodson, R. E. 1961. KEEP OUT FISH ELECTRICALLY. Amer. City, 76, No. 2, 95-96; Water Pollution Abstracts, Vol. 34, No. 12, Abst. No. 2174. 1961.

The author describes the electric fish screens installed at the outlets of the reservoirs at San Diego, Calif. (see Wat. Pollut. Abstr., 1958, 31, Abstr. No 1510), to prevent the entry of fish into the water-treatment plant, particularly the filters. The apparatus produces a direct current which repels the fish. Details of the apparatus, with illustrations, and of its installation, are given.

4845. Bullivant, J. S. 1961. THE INFLUENCE OF SALINITY ON THE RATE OF OXYGEN CONSUMPTION OF YOUNG QUINNAT SALMON, ONCORHYNCUS TSCHAWYTSCHA. N. Z. J. Sci. 4, 381-391; Water Pollution Abstracts, Vol. 34, No. 12, Abst. No. 2210. 1961.

Comparative experiments with young quinnat salmon, Oncorhyncus tschawytscha, in fresh water, sea water, and mixtures containing equal parts of fresh water and sea water, confirmed that the rate of growth is affected by the salinity, but no significant difference could be found between the rates of oxygen consumption of resting fish in the waters of different salinities. This observation would be expected if the energy expended on osmoregulation is a small proportion of the total energy consumption, as was calculated previously for certain freshwater invertebrates. The evidence suggests that where a change in the respiration rate of an aquatic animal has been correlated with changes in the salinity or osmotic pressure of the external medium, this is due to an initial breakdown in osmoregulation followed by a disturbance of tissue metabolism.

4846. Bringmann, G., and R. Kuhn. 1960. TOXICOLOGICAL INVESTIGATIONS ON INSECTICIDES IN WATER. Gesundheitsing., 81, 243-244; Water Pollution Abstracts, Vol. 34, No. 12, Abst. No. 2366. 1961.

Experiments are described on the toxicity of a number of insecticides (organic phosphorus compounds, chlorinated hydrocarbons, and systemic insecticides) to young Daphnia (less than 24 hours old) and the results are compared with the toxicities of inorganic and organic poisons. The method of maintaining the supply of Daphnia and a standardized method of testing, using test-tubes containing 10 ml of liquid and 10 organisms, are described. None of the other substances tested was comparable in toxicity to the organic phosphorus compounds.

4847. Gaufin, A. R. 1960. BIO-ASSAYS TO DETERMINE THE TOXICITY OF PESTICIDES TO AQUATIC INVERTEBRATES. Proc. 15th industr. Waste Conf., Purdue Univ. Engng. Extn Ser. No. 106, 94-98; Water Pollution Abstracts, Vol. 34, No. 12, Abst. No. 2367. 1961.

The author describes the results of bio-assays carried out at the University of Utah on the toxicity of 3 common insecticides--DDT, malathion, and parathion--to aquatic invertebrates. The test organisms were 3 species of stoneflies, Acroneuria pacifica, Pteronarcys californica and Claassenia sabulosa, and one species of caddis fly, Arctopsyche gradis, which are commonly found in streams near Salt Lake City and are an important source of food for trout. A hard dilution water, of similar chemical quality to the streams in which the test organisms were collected, was used in the experiments. The first symptom of toxicity was a period of excitability with little or no loss of coordination; this was followed by loss of coordination, loss of balance, and finally death. Large organisms were found to be more resistant than smaller specimens, particularly in the case of Pteronarcys californica. Parathion was the most toxic of the insecticides tested, a concentration of 0.0001 p.p.m. being toxic to Acroneuria pacifica, and DDT was least toxic, a concentration of 0.18 p.p.m. being tolerated by Acroneuria.

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ABSTRACTORS OTHER THAN AUTHORS AND STAFF:

Biological Abstracts
Chemical Abstracts
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